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53D CONGRESS, 3d Session. } SENATE. { EX. DOC. 8, PART I.

REPORT OF THE SUPERINTENDENT

OF THE

U. S. COAST AND GEODETIC SURVEY

SHOWING

THE PROGRESS OF THE WORK

DURING THE

FISCAL YEAR ENDING

WITH

JUNE, 1894.

IN TWO PARTS.

PART I.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1895.

BIBLIOTHECA
REGIA
MONACENSIS

LETTER

FROM

THE ACTING SECRETARY OF THE TREASURY.

TRANSMITTING

A Report from the Superintendent of the U. S. Coast and Geodetic Survey, showing the progress of work during the year ended June 30, 1894.

TREASURY DEPARTMENT,
OFFICE OF THE SECRETARY, *December 7, 1894.*

SIR: In compliance with the requirements of Section 4690, Revised Statutes, I have the honor to transmit herewith, for the information of Congress, a report addressed to this Department by W. W. Duffield, Superintendent U. S. Coast and Geodetic Survey, showing the progress made in that work during the fiscal year ended June 30, 1894, and accompanied by maps illustrating the general advance in the operations of the Survey up to that date.

Respectfully yours,

W. E. CURTIS,
Acting Secretary.

To the Honorable
THE VICE-PRESIDENT OF THE UNITED STATES
AND PRESIDENT OF THE SENATE

December 11, 1894. Ordered to lie on the table and be printed.

LETTER OF TRANSMISSION.

United States Coast and Geodetic Survey,
Washington, D. C., December 4, 1894.

Sir: In conformity with law and the regulations of the Treasury Department I have the honor to submit herewith, for transmission to Congress, the Annual Report on the progress of the Coast and Geodetic Survey for the fiscal year ending June 30, 1894. It is accompanied by maps illustrating the general advance in the field work of the Survey up to that date.

My appointment to the superintendency of the Survey on September 20, 1894, devolved upon me the preparation, in part, of this report which relates to work done under the direction of my predecessor in office.

Very respectfully yours,

W. W. Duffield,
Superintendent.

Hon. J. G. Carlisle,
Secretary of the Treasury.

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REPORT.

PART I.

In the general statement of progress which is given in the following pages will be found a reference to the various operations in the field, carried on during the fiscal year ending June 30, 1894. This statement appears again in the still more brief form of Table No. 1, showing the distribution of about seventy-seven field parties; but under the heading of "Abstracts of Reports from Field Parties" will be found an account of the several operations in greater detail.

The general progress of the field work of the Survey is shown as heretofore, graphically on the appended progress sketches embracing the United States, and on a third map referring to Alaska. Much of the important work of the Survey, however, does not appear on the maps or in the synoptical statements relating to field work. Reference to it must be sought in the Abstract of Office Reports, in the reports themselves, which are published in full, and in the Appendices. The Office Reports relate to the construction, publication, and distribution of maps and charts, the discussion of geodetic, astronomical, and magnetic observations, and the reduction of hydrographic data, such as current and tidal observations accumulated by the Survey, the latter for the purpose of publishing in advance the prediction of tides in the form of tables embracing all the coasts of the United States and some foreign ports. It is contemplated to include, in the near future, all the principal foreign ports.

Among the field operations the following special ones may be mentioned: The survey of the northeastern boundary lakes was completed. Surveys were made by the Superintendent in person for the purpose of determining conjointly with the Commissioner of the Dominion of Canada on a method of defining, with greater accuracy, the boundary lines between the two countries in the waters of Passamaquoddy Bay. The international surveys, in connection with the Alaska boundary question, were pushed with vigor in the short season during which such surveys can be advantageously made.

The reconnaissance for a triangulation was continued down the Rio Grande towards the Gulf, with a view to the ultimate location of that portion of the international boundary included within the limits of the reconnaissance.

The survey of the interstate boundary between California and Nevada, from Lake Tahoe towards the Colorado River, was continued. A survey was made of the Outer Diamond Shoal, off Cape Hatteras, for the use of the Light-House Board in the proposed construction of a light-house in that locality. At the request of the Navy Department the trial course in the Santa Barbara Channel was extended, and two vessels of the Survey cooperated in the speed trial of the new cruiser *Olympia*.

For the United States Commissioner of Fish and Fisheries an examination was made of the location and limits of the natural oyster beds in Mobile Bay, and the surveys in the waters of Virginia, made for a similar purpose at the request of the State, were continued.

SPECIAL DUTY.

The assignments of two officers of the Survey to special duty by appointment of the President are still in force. Assistant Henry L. Whiting is serving as a member of the Mississippi River Commission, and Assistant A. T. Mosman as a member of the International Boundary Commission, organized for the relocation of that part of the United States and Mexican boundary line extending from the Rio Grande to the Pacific.

WORLD'S COLUMBIAN EXPOSITION.

An account of the part taken by this Office in the Government exhibit, made at the World's Exposition at Chicago, is given in the last annual report. It is there published as Appendix 10, and was prepared by Assistant Dallas B. Wainwright, who installed the exhibit and supervised its removal at the close of the Exposition.

ABSOLUTE GRAVITY AT WASHINGTON.

Taking advantage of the presence in this country of Commandant Defforges of the French army, the Superintendent requested the director of the "Service Geographique" to authorize Commandant Defforges to make a determination of the absolute gravity at the Coast and Geodetic Survey Office pendulum station. This request was courteously complied with, and Commandant Defforges closed the series of relative determinations, which he had made for the Academy of Sciences of France, at San Francisco, Mount Hamilton, Salt Lake, Denver, Chicago, Montreal, and Washington, by making the desired absolute determination at this Office with the Brunner pendulums, during October, 1893.

ARRANGEMENT OF THIS REPORT.

The geographical arrangement adopted in 1891 for the convenient classification of different localities of work has been retained in this volume, and, accordingly, the field work is described under the headings: "Eastern Division," "Middle Division," "Western Division," and "Division of Alaska," while that of "Special Operations" is devoted to special duties devolved on the Survey during the fiscal year.

The general account of field and office operations, with the accompanying tabular abstracts, is followed by the Office Reports, and by Progress Sketches, which complete Part I.

Part II contains appendices relating to the methods, discussions, and results of the Coast and Geodetic Survey.

GENERAL STATEMENT OF PROGRESS.

FIELD WORK.

EASTERN DIVISION.—*States east of the Mississippi River.*—During the fiscal year ending June 30, 1894, the following-named operations were in progress or completed in the Eastern Division, which comprises the States and coasts east of the Mississippi River:

Completion of the hydrographic survey of the northeastern boundary lakes; surveys of northeastern boundary line in Passamaquoddy Bay; hydrographic examinations for the Atlantic Coast Pilot; topographic and hydrographic resurvey of Boston Harbor and Bay continued; leveling of precision and town boundary surveys in Massachusetts continued; relative gravity determined between Boston and Cambridge; physical hydrographic survey of the north shore of Nantucket Island; automatic tidal station continued at Fort Adams, Newport Harbor; topography of the Connecticut River continued and completed; resurvey of the shores of Long Island continued; observations for relative gravity made at Ithaca, New York; topography of the Hudson River continued; automatic tide gauges maintained at Willets Point and Fort Hamilton, New York; triangulation for furnishing points for State surveys continued in southwestern New Jersey; base line measured in Baltimore; relative gravity determined between Baltimore and Washington, D. C.; automatic tidal station continued in Washington, D. C.; observations for variation of latitude made at Rockville, Maryland. Experimental leveling continued in Washington, D. C., defining limiting lines of natural oyster beds in the waters of Virginia; relative gravity observed between Washington, D. C. and Charlottesville, Virginia; hydrographic examination of the Outer Diamond Shoal, off Cape Hatteras, for the Light-House Board; topography and hydrography of the Cooper, Ashley, and Wanda rivers, South Carolina, continued; hydrographic surveys in St. Simons Sound and in Savannah River; geodetic leveling across Florida continued; hydrographic surveys in St. Lucie Inlet, Key West, and Tampa Bay; resurvey of Pensacola Bay and approaches; topographic and hydrographic survey of tributaries of Pensacola Bay; reconnaissance completed in southern Alabama for the extension of the triangulation to the Gulf Coast; defining limiting lines of natural oyster beds in Mobile Bay; continuation of the triangulation in eastern Tennessee to connect with the triangulation of the Blue Ridge.

MIDDLE DIVISION.—*States and Territories between the Mississippi River and the Rocky Mountains.*—The following operations show the activity of the Survey within the limits of the Middle Division:

Triangulation in aid of State surveys in Minnesota; completion of the thirty-ninth parallel triangulation in Kansas; continuation of precise levels in Kansas, Missouri, and Arkansas; reconnaissance for triangulation along the Rio Grande toward the Gulf; continuation of self-registering magnetic station in Texas.

WESTERN DIVISION.—*States and Territories between the Rocky Mountains and the Pacific Ocean.*—The following operations were in progress or completed within the limits of the Western Division on and off shore:

Hydrographic examinations at San Diego and San Pedro; cooperation in speed trial of U. S. cruiser *Olympia*; determination of wrecks near Point Sur and Point Bonita; hydrographic and topographic resurvey of San Francisco Entrance and Harbor; continuation of automatic tide gauge at Sausalito; telegraphic longitudes between Tacoma and Seattle and between San Francisco and Eugene, Oregon; location and marking of the boundary line between California and Nevada, from Lake Tahoe to the Colorado; hydrographic survey, coast of Washington, between James Island and Arch Rock; triangulation of the Strait of Juan de Fuca and Washington Sound; hydrographic survey of the Strait of Juan de Fuca; continuation of the triangulation along the thirty-ninth parallel in Utah and Colorado; reconnaissance for triangulation in Colorado.

DIVISION OF ALASKA.—*This division includes the coasts of Alaska bordering upon the Pacific Ocean, upon Bering Sea, and upon the Arctic Ocean.*—The following work was in progress or completed:

Hydrographic and general surveys of Sitka Sound, Sitka Harbor and approaches, and in Chatham Straits; development of ledges in Felice Straits and Kasaan Bay; chronometric longitude determinations completed between Burroughs Bay, Fort Wrangell, Taku Inlet, and Sitka, and begun between Sitka and Pyramid Harbor; reconnaissance survey of the Unuk and Stikine rivers and Taku Inlet completed; explorations made at Holkham Bay and surveys on Chilkat and Taiya Inlets begun; development of coast line from Cape Manby to Icy Cape made, and its relation to interior peaks determined.

BULLETINS.

The last annual report mentions the publication on July 20, 1893, of Bulletin No. 27. The other bulletins published during the fiscal year are the following:

No. 28.—The Constant of Aberration as determined from a Discussion of Results for Latitude at Waikiki, Hawaiian Islands. A report by E. D. Preston, Assistant.

No. 29.—The Methods and Results of the U. S. Coast and Geodetic Survey as illustrated at the World's Columbian Exposition.

No. 30.—Units of Electrical Measure.

NOTICES TO MARINERS.

Notices to Mariners were published monthly during the year, as heretofore, and were distributed free. They contain notices affecting the data on the printed charts and supply new information. During the year announcements were made of rocks discovered in Fox Island Thoroughfare, Kennebec River; of a rock off Middle Point, Strait of San Juan de Fuca; and of rocks and reefs discovered in Alaskan waters as follows: Off Point Lookout, Stephens Passage; in Eastern Channel, Sitka; in Kasaan Bay, and in Felice Straits.

The February notice contains an illustrated account of the tidal indicator at Fort Hamilton, New York, which has continued to operate satisfactorily.

GEODETIC CONFERENCE.

The wide geographical extent of our own country and its diverse topographic and climatic conditions call for different methods and devices for carrying on the work of the Survey. By bringing together the officers conducting the work under such different conditions, the valuable experience gained by individuals could be made the common property of all. The personal interchange of ideas regarding the ways and means of carrying on the work, together with a general comparison of the practice of foreign nations with our own, would, it was felt, promote economy, accuracy, and rapidity in the execution of work. These conditions, which led to a conference of topographers of the Survey in 1892, induced the Superintendent to convene as many of the officers engaged on geodetic work as could be assembled to meet at Washington on January 9, 1894. The conference remained in session until February 28, and was composed of the following members:

Messrs. George Davidson, Chas. A. Schott, George A. Fairfield, William Eimbeck, O. H. Tittmann, J. J. Gilbert, F. W. Perkins, Edwin Smith, J. F. Pratt, C. H. Sinclair, E. F. Dickins, Stehman Forney, J. E. McGrath, Isaac Winston, P. A. Welker, Fremont Morse, W. B. Fairfield, F. A. Young, G. R. Putnam, A. L. Baldwin, O. B. French, R. L. Faris, S. B. Tinsley, C. H. Van Orden.

Prof. A. H. Buchanan and Prof. W. R. Hoag, Acting Assistants, took part in the meetings of the conference for a short time. Prof. Wm. Harkness, U. S. N., Prof. R. E. Woodward, of Columbia College, New York, and Prof. J. H. Gore, of Columbian University, Washington, addressed the conference on special topics.

Assistant George Davidson was designated by the Superintendent to act as chairman, and Assistant O. H. Tittmann to act as secretary.

The proceedings of the conference have been published as Appendix 9, United States Coast and Geodetic Survey Report for 1893.

EXPLANATION OF ESTIMATES.

The estimates submitted to the Secretary of the Treasury for the fiscal year 1896 were accompanied by the following explanations:

United States Coast and Geodetic Survey,
Office of the Superintendent,
Washington, D. C., October 31, 1894.

Sir: I have the honor to transmit herewith the estimates for the expenses of the Coast and Geodetic Survey for the fiscal year 1896, and I beg leave to submit the following explanation relative thereto:

Under the head of "Field Expenses" an increase of $66 200 is asked for, as the present appropriations are found to be inadequate and do not permit of the most efficient and economical administration of the work, too large a proportional part being necessarily expended in the organization of parties and their transportation to and from the field. This increase is distributed among the various subitems of the appropriation for "Field Expenses," and, if granted, will result in a large increase in the output of field work and at a smaller relative cost.

Under the head of "Repairs and Maintenance of Vessels," an item of $18 000 for a new boiler and spar deck for the steamer *Patterson* has been inserted, and this is now absolutely necessary. The annual appropriation of $25 000 has for years been inadequate, as many of the vessels are now old and require frequent and extensive repairs. The repairs of the *Patterson* have, in consequence of lack of funds, been delayed from time to time until further postponement is impracticable and unsafe.

The "Pay of Field Force" remains as under the recent reorganization, and in the "Pay of Office Force" the only changes proposed are the reduction of one engraver from $1 800 to $1 200, and the increase of one clerk from $1 200 to $1 650, as recommended in my letter of October 25. Other sections of the estimates for the Coast and Geodetic Survey remain as in the current year's appropriation act.

In the "Office of Construction of Standard Weights and Measures" the only change is in the compensation of the adjuster, the proposed increase being $300, and this is strongly recommended as a reward for faithful and efficient service.

Respectfully yours,
W. W. Duffield,
Superintendent.

The Honorable the Secretary of the Treasury,
Washington, D. C.

ESTIMATES OF EXPENDITURE FOR THE FISCAL YEAR ENDING JUNE 30, 1896.

For every expenditure requisite for and incident to the survey of the Atlantic, Gulf, and Pacific coasts of the United States and the coast of the Territory of Alaska, including the survey of rivers to the head of tide water or ship navigation; deep-sea soundings, temperature and current observations along the coast and throughout the Gulf Stream and Japan Stream flowing off the said coasts; tidal observations; the necessary resurveys; the preparation of the Coast Pilot; continuing researches and other work relating to terrestrial magnetism and the magnetic maps of the United States and adjacent waters, and the tables of magnetic declination, dip, and intensity usually accompanying them; and including compensation not otherwise appropriated for of persons employed on the field work, in conformity with the regulations for the government of the Coast and Geodetic Survey adopted by the Secretary of the Treasury; for special examinations that may be required by the Light-House Board or other proper authority, and including traveling expenses of officers and men of the Navy on duty; for commutation to officers of the field force while on field duty, at a rate to be fixed by the Secretary of the Treasury not exceeding $2 50 per day each; outfit, equipment, and care of vessels used in the Survey, and also the repairs and maintenance of the complement of vessels; to be expended in accordance with the regulations relating to the Coast and Geodetic Survey from time to time prescribed by the Secretary of the Treasury, and under the following heads: *Provided*, That no advance of money to chiefs of field parties under this appropriation shall be made unless to a commissioned officer or to a civilian officer who shall give bond in such sum as the Secretary of the Treasury may direct:

FOR FIELD EXPENSES:

For survey of unfinished portions of the Atlantic coast from Maine to Florida, including the coast of New Brunswick eastward to Point Lepreau; Grand Manan Island; Portsmouth Harbor, and Piscataqua River; Newburyport Harbor and Merrimac River to Haverhill; Hudson River to Troy; Bogue Inlet and interior waters along the coast of North Carolina; Charleston Bar and Entrance, South Carolina; and necessary resurveys, including Boston Harbor, Buzzards Bay, coast of New Jersey from Sandy Hook to Cape May, Chesapeake Bay and tributaries, Bar and Entrance to Brunswick Harbor, Savannah Bar and River, Georgia; St. Johns River to Jacksonville, and Fort George Inlet	$30 000
To continue the primary triangulation from the vicinity of Montgomery toward Mobile; and for triangulation, topography, and hydrography of unfinished portions of the Gulf coast, including interior waters of west coast of Florida from Cape Romano to Cape Sable; Lakes Pontchartrain and Maurepas, Louisiana, and for the necessary resurveys	12 000
To make offshore soundings along the Atlantic and Gulf coasts and current and temperature observations in the Gulf Stream	8 000
For continuing the survey of the coasts of California, Oregon, and Washington, including offshore hydrography, the survey of the Columbia River to the Cascades, a detailed survey in the vicinity of the Farallones, the continuation of the primary triangulation, and for necessary resurveys, including San Francisco Harbor, triangulation, topography, and hydrography	25 000
For continuing explorations in the waters of Alaska and making hydrographic surveys in the same, including survey of the Aleutian Islands, and examination of the mouth of the Yukon River, and for the establishment of latitude, longitude, and magnetic stations	15 000
For continuing the researches in physical hydrography relating to harbors and bars, including computations and plottings, and for continuing tidal and current observations on the Atlantic, Gulf, and Pacific coasts	12 000
For the establishment and maintenance, for one year, of a self-registering tide gauge at the ocean pier at St. Simons Island, Brunswick Entrance, Georgia	1 500

For examination of reported dangers on the Atlantic, Gulf, and Pacific coasts, and to continue the compilation of the Coast Pilot and to make special hydrographic examinations for the same	$5 000
To continue magnetic observations, including the maintenance of the Magnetic Observatory	4 000
For continuing the line of exact levels westward and southward from the vicinity of Kansas City, Missouri; westward from Old Point Comfort, Virginia; eastward from San Francisco, California; eastward from Vicksburg, Mississippi, and from the vicinity of Chicago, Illinois, to Lake Erie	5 000
For furnishing points to State surveys, to be applied as far as practicable in States where points have not been furnished; and for surveying and distinctly marking with permanent monuments that portion of the eastern boundary of the State of California commencing at and running southeastward from the intersection of the thirty-ninth degree of north latitude with the one hundred and twentieth degree of longitude west from Greenwich	20 000
For determinations of geographical positions, including telegraphic connection with Montreal, and to continue gravity observations	5 000
For completing the transcontinental geodetic work on the line between the Atlantic and Pacific oceans, including a primary base in the vicinity of Salt Lake, and the necessary check bases	20 000
For traveling expenses of officers and men of the Navy on duty, and for any special surveys that may be required by the Light-House Board or other proper authority, and contingent expenses incident thereto	3 500
For objects not hereinbefore named that may be deemed urgent, including the actual necessary expenses of officers of the field force temporarily ordered to the office at Washington for consultation with the Superintendent, to be paid as directed by the Superintendent, in accordance with the Treasury regulations	8 000
[For contribution to the International Geodetic Association for the Measurement of the Earth, $550, or so much thereof as may be necessary, to be expended through the office of the American Legation at Berlin; and for expenses of the attendance of the American delegate at the general conference of said association, $550, or as much thereof as may be necessary: *Provided,* That such contribution and expenses of attendance shall be payable out of the item, "for objects not hereinbefore named;" and 20 per centum of the foregoing amounts shall be available interchangeably for expenditure on the objects named.]	
In all, for field expenses	$174 000
(And this amount shall be immediately available.)	

FOR REPAIRS AND MAINTENANCE OF VESSELS:

For repairs and maintenance of the complement of vessels used in the Coast and Geodetic Survey	$25 000
For new main boiler and new spar deck for the steamer *Patterson*	18 000
	$43 000

PAY OF FIELD OFFICERS:

For Superintendent	$6 000
For two assistants, at $4 000 each	8 000
For one assistant	3 500
For four assistants, at $3 000 each	12 000
For four assistants, at $2 500 each	10 000
For eight assistants, at $2 200 each	17 600
For eight assistants, at $2 000 each	16 000
For four assistants, at $1 800 each	7 200
For four assistants, at $1 600 each	6 400
For three assistants, at $1 400 each	4 200
For four assistants, at $1 200 each	4 800
For aids temporarily employed at a salary not greater than $900 per annum each	3 600
In all	$99 300

PAY OF OFFICE FORCE:

For one disbursing agent	$2 200
For one general office assistant	1 800
For one chief of division of library and archives	1 800
For one clerk to the Superintendent	1 200
For one clerk to the assistant in charge of office and topography	1 000
For clerical force, namely:	
For three, at $1 650 each	4 950
For three, at $1 400 each	4 200
For four, at $1 200 each	4 800
For three, at $1 000 each	3 000
For chart correctors, buoy colorists, stenographers, writers, typewriters, and copyists, namely:	
For two, at $1 200 each	2 400
For three, at $900 each	2 700
For one at $800	800
For seven, at $720 each	5 040
For one at $600	600
For topographic and hydrographic draughtsmen, namely:	
For one, at $2 400	2 400
For one, at $2 200	2 200
For two, at $2 000 each	4 000
For three, at $1 800 each	5 400
For two, at $1 400 each	2 800
For one, at $1 200	1 200
For two, at $1 000 each	2 000
For two, at $900 each	1 800
For astronomical, geodetic, tidal, and miscellaneous computers, namely:	
For two, at $2 000 each	4 000
For three, at $1 600 each	4 800
For two, at $1 400 each	2 800
For two, at $1 200 each	2 400
For two, at $1 000 each	2 000

For copperplate engravers, namely:

For two, at $2 000 each	4 000
For two, at $1 800 each	3 600
For two, at $1 600 each	3 200
For two, at $1 200 each	2 400
For one, at $1 000	1 000
For additional engravers, at not to exceed $900 per annum each	4 000

For electrotypers and photographers, plate printers and their helpers, instrument makers, carpenters, engineer, and other skilled laborers, namely:

For two, at $1 800 each	3 600
For one, at $1 600	1 600
For two, at $1 200 each	2 400
For ten, at $1 000 each	10 000
For two, at $900 each	1 800
For seven, at $700 each	4 900

For watchmen, firemen, messengers and laborers, packers and folders, and miscellaneous work, namely:

For three, at $880 each	2 640
For six, at $820 each	4 920
For two, at $700 each	1 400
For three, at $640 each	1 920
For four, at $630 each	2 520
For four, at $550 each	2 200
For two, at $365 each	730
In all, for pay of office force	$133 120

OFFICE EXPENSES:

For the purchase of new instruments, for materials and supplies required in the instrument shop, carpenter shop, and drawing division, and for books, maps, charts, and subscriptions	$8 000
For copperplates, chart paper, printers' ink, copper, zinc, and chemicals for electrotyping and photographing; engraving, printing, photographing, and electrotyping supplies; for extra engraving and drawing, and for photolithographing charts and printing from stone and copper for immediate use	18 000
For stationery for the office and field parties, transportation of instruments and supplies, when not charged to party expenses, office wagon and horses, fuel, gas, telegrams, ice, and washing	6 000
For miscellaneous expenses, contingencies of all kinds, office furniture, repairs, and extra labor, and for traveling expenses of assistants and others employed in the office sent on special duty in the service of the office	4 500
	$36 500

For the discussion and publication of observations	$1 000

That no part of the money herein appropriated for the Coast and Geodetic Survey shall be available for allowance to civilian or other officers for subsistence while on duty at Washington (except as hereinbefore provided for officers of the field force ordered to Washington for short periods for consultation with the Superintendent), or to officers of the Navy attached to the Survey, except as now provided by law.

PRINTING AND BINDING:

Printing and lithographing, photo-lithographing, photo-engraving, and all forms of illustrations done by the Public Printer, on requisition by the Treasury Department, for the Coast and Geodetic Survey, namely:

Tide tables, Coast Pilots, appendices to the Superintendent's annual reports, published separately; notices to mariners, circulars, blank books, blank forms, and miscellaneous printing, including the cost of all binding and covering; the necessary stock and materials and binding for the library and archives	$20 935

NOTE.—No engraving is done by the Public Printer for the Coast and Geodetic Survey.

Total Coast and Geodetic Survey, exclusive of printing and binding	$486 920

OFFICE OF CONSTRUCTION OF STANDARD WEIGHTS AND MEASURES:

Salaries, Office of Standard Weights and Measures:

For construction and verification of standard weights and measures, including metric standards for the custom-houses, other offices of the United States, and for the several States, and mural standards of length in Washington, D. C.:

For one adjuster, at $1 800	$1 800
For one mechanician, at $1 250	1 250
For one assistant messenger and one watchman	1 440
In all	$4 490

Contingent Expenses, Office of Standard Weights and Measures:

For purchase of materials and apparatus and incidental expenses	$500
For expenses of attendance of the American member of the International Committee on Weights and Measures at the general conference provided for in the convention signed May 20, 1875, the sum of $475, or as much thereof as may be necessary	475
	$975

ABSTRACTS OF REPORTS FROM FIELD PARTIES, FISCAL YEAR, 1894.

EASTERN DIVISION.

STATES EAST OF THE MISSISSIPPI RIVER.

1. Maine.
2. New Hampshire.
3. Vermont.
4. Massachusetts.
5. Rhode Island.
6. Connecticut.
7. New York.
8. New Jersey.
9. Pennsylvania.
10. Delaware.
11. Maryland.
12. District of Columbia.
13. Virginia.
14. North Carolina.
15. South Carolina.
16. Georgia.
17. Florida.
18. Alabama.
19. Mississippi.
20. Michigan.
21. Wisconsin.
22. Ohio.
23. Indiana.
24. Illinois.
25. West Virginia.
26. Kentucky.
27. Tennessee.

The localities of field operations in the Eastern Division are shown in Progress Sketches Nos. 1, 5, 6, 7, 8, 9, 10, 16, and 17.

Completion of the hydrographic survey of the Northeastern Boundary Lakes.—Instructions having been issued to Assistant Stehman Forney, June 29, 1893, directing him to resume and carry to completion the hydrographic survey of the chain of lakes known as the Schoodic Lakes, which, with the St. Croix River, form part of the northeastern boundary between the United States and the Dominion of Canada, Mr. Forney proceeded to Forest City, Maine, and, on July 10, took up the work from the limits of the survey of the preceding season at the southern end of Grand Lake.

The three projections furnished to him, each on a scale of 1-10 000, included within their limits Grand Lake at its south end, Chipuneticook Lake, Mud Lake, and Lake Palfrey, with their numerous coves and tributaries extending to the town of Vanceboro. Close soundings were taken to develop the main or deep-water channel from Vanceboro to Forest City, and the adjacent coves and bays were covered with a sufficient number of soundings to show the general character of the bottom and to make the survey complete.

Mr. Forney noted that the water in Chipuneticook Lake was 5 feet lower than when Assistant Flemer surveyed the shore line of the lake in 1891. This condition involved much extra work in locating points for hydrographic determinations.

He observes in his report that the Schoodic Lakes are navigable for light-draft vessels, but the waterways connecting them with each other have many rapids, are very shallow, and are only passable by canoes and batteaux. The lakes are used chiefly for mooring logs and bark. One light-draft stern-wheel steamer navigates Grand and North lakes, and three steam cutters navigate Chipuneticook and Palfrey lakes. The large timber along these lakes and their tributaries is being rapidly exhausted, nothing but a very small growth of timber being left. Fish are also very scarce, owing to the great amount of netting which has been and is still carried on on the Canadian side of the lakes. Dams built by a cannery company at Forest City, at the northern end of Mud Lake and at Vanceboro, prevent the fish from ascending above the St. Croix River in the spawning season.

Mr. Forney acknowledges efficient assistance received from Messrs. H. A. Pressy, R. F. Whitehead, and Carl. P. Halter, recorders in his party.

Field operations were closed October 11. The statistics are as follows:

Hydrography:

Area sounded in square geographical miles	30
Number of miles (geographical) run while sounding	351
Number of angles measured	3 716
Number of soundings	33 396

Reference is made under a heading in the Middle Division to duty assigned to Assistant Forney on the Rio Grande.

Hydrographic examinations on the northwest coast of the Gulf of Maine and on the north shore of Long Island Sound between Hammonassett Point, Connecticut, and Rye, New York.—Also verifications of sailing lines and collection of information for mariners between Coney Island, New York, and Cape Charles, Virginia, for the Coast Pilot.—Early in July, 1893, after having finished duty assigned to him with the Superintendent in Eastport Harbor and approaches, Lieut. E. H. Tillman, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *Endeavor*, took up certain special hydrographic examinations on the coast of Maine. The localities examined were Carvers Cove, Linekins Bay and St. Georges River. In Carvers Cove, Fox Islands Thoroughfare, the examination developed the existence of a rock with 18 feet of water over it at low tide. The position and bearings of this rock were published in Notice to Mariners No. 169, for July, 1893. No tidal observations were taken in connection with these examinations, the soundings being reduced from data derived from the Atlantic Coast Tide Tables for 1893.

Lieutenant Tillman testifies to the accuracy of the shore line or high-water mark as delineated on tracings furnished by the Office from the topographic sheets. He observes, however, that the coast is undergoing such rapid and marked changes of an artificial nature through the addition of roadways, large cottages, and summerhouses, that in many cases it was found impossible to distinguish and use houses shown on former surveys as points for reference or signals in hydrography.

All of the records, sheets, and tracings of the work on the coast of Maine were forwarded to the Office on July 17.

After having obtained coal and stores, etc., in Boston, Lieutenant Tillman proceeded to Great Peconic Bay to get two boats from Westhampton, Long Island. These boats had to be taken over 12 miles by water through intricate and narrow sloughs, and through Shinnecock Bay and Canal. There is but a foot of water in many places in this canal, and in one place, where a bridge and tide gate were in course of construction, it was completely dammed up.

From July 24 to September 9, Lieutenant Tillman was occupied with his party in making special hydrographic examinations and running lines of soundings as indicated on charts and tracings furnished by the Office at numerous localities on the north shore of Long Island Sound between Hammonassett Point, Connecticut, and Rye, New York.

The tidal bench marks at Falkner Island, Money Island, and Greenwich were found to be in a good state of preservation and were used to obtain planes of reference for the soundings. The bench marks formerly at Bridgeport, Saugatuck River, and Wilson's Point had disappeared. At the last-named point, consecutive high and low waters were observed for several days to establish a plane of mean low water, and the observations of Lieutenant Stuart, in 1885, were used in connection with those of this year to compute the mean range.

In searching for reported isolated rocks or ledges, local authorities were often consulted, and the information thus received was frequently of much value. As the results of the examinations were needed at the Office for corrections and additions to charts already issued, the entire party took up office work whenever bad weather prevented boat work, and all data and results of the hydrography were transmitted to the Office with the least practicable delay.

Field work was closed September 9 and Lieutenant Tillman then began, under instructions, a series of verifications of sailing lines and the collection of information of importance to mariners for use in the publication of the Coast Pilot relating to that part of the coast between Coney Island, New York, and Cape Charles, Virginia, including New York Bay, Hudson River, and Delaware Bay. In prosecuting this work, much delay was caused by the prevalence of stormy weather, so that only the lines for the more important bodies of water were verified.

Incidental to this duty, careful determinations were made of the geographical positions of the light-vessels at the NE. end of Five Fathom Bank; on Five Fathom Bank, N. J., and on Winter Quarter Shoal, Virginia.

On October 1, Lieutenant Tillman left the Delaware Breakwater in the *Endeavor* for Baltimore, and at the end of the month he was instructed to resume his duties as Chief of the Coast Pilot Division in the Office, having been previously relieved in command of the *Endeavor* by Lieut. L. M. Garrett, U. S. N.

Ensign F. B. Bassett, U. S. N., was attached to the party for about a month at the outset of the season; on July 18 he was detached and ordered to the schooner *Eagre*. Mr. John Ross, compiler in the Coast Pilot Division rendered efficient service throughout the season as observer and draughtsman. Pay Yeoman C. L. Green served as recorder, and valuable aid in office work was given by Mr. A. J. Miskimon, in charge of the engineer's department.

Statistics of the hydrographic examinations, beginning June 29 and ending September 9, 1893, are reported by Lieutenant Tillman as follows:

Hydrography:

Number of miles (nautical) run in soundings	127
Number of angles measured	3 072
Number of soundings	15 126
Number of rocks found and located	36

Continuation of the topographic resurvey of Boston Harbor to include Nantasket Beach and most of the inner and outer islands of the Harbor.—The resumption of the topographic resurvey of Boston Harbor by Assistant R. Meade Bache, early in June, 1893, was adverted to in the last annual report.

By October 21, when field operations were suspended for the season, two topographic sheets, each on a scale of 1–10 000, had been completed, on which were delineated the shore lines of Nantasket Beach and of the peninsula from Point Allerton to Windmill Point, the shore lines of Peddocks, Moon, Thompsons, Long, Lovells, and other islands in their vicinity, and all of the topographic details included in their areas and in the area of Nantasket Peninsula.

Mr. Bache observes in his report that the character of the topography, essentially like that delineated by him during the preceding season, consisted of intricate shore-line and diversified elevations, conspicuous among which were long, unwooded, egg-shaped hills, the whole covered with many artificial details.

Following are the statistics of the season's work:

Topography:

Area surveyed in square statute miles	30
Length of general coast line in statute miles	52·8
Length of shore line of creeks in statute miles	3·1
Length of shore line of ponds in statute miles	3
Length of roads in statute miles	31·2

The islands of which the shore line was surveyed were twenty-three in number, and from 200 to 2 816 metres in length.

Topographic resurvey of Boston Harbor, continued from Deer Island to Breeds Island and Chelsea Beach, including shore line and area contiguous thereto.—At the beginning of the fiscal year the party in charge of Assistant C. T. Iardella had been in the field since June 9, under instructions to resume the topographic resurvey of Boston Harbor from the limits of the work of the preceding season. As stated in the last annual report, the weather was unfavorable till near the end of June. Winthrop Beach was surveyed during that month, and on the 1st of July Mr. Iardella began a topographic survey of Deer Island. His work was laid out on two projections, each on a scale of 1-10 000—No. 1 including an area between Deer Island and Beachmont, No. 2 from Beachmont to Point of Pines.

Referring to the great changes in the aspect of the country since 1860, when the last survey was made, Mr. Iardella observes that between Point Shirley and Point of Pines there were at that time but very few inhabitants. Winthrop Center and vicinity then contained about twenty-five houses and three streets; it now contains about two hundred houses, six churches, three large schoolhouses and about forty streets. On Winthrop Beach, from Winthrop Head to Grover's Cliff, there were no houses and but two streets; there are now, within these limits, more than seventy-five streets and over three hundred and fifty houses, including cottages. Between Grover's Cliff and Oak Island, a distance of 4 miles, there are a great number of dwellings and short streets.

Revere Beach is thought to be one of the finest bathing shores on the Atlantic Coast, rivaling Cape May in some respects. The sand is of a bluish color and perfectly free from pebbles or shells of any kind. The country from East Boston to Breeds Island, now called Orient Heights, is thickly settled.

Within a few years past Revere and Winthrop have attracted attention as convenient and salubrious places for summer residence, and the localities of Ocean Spray and Beachmont, bordering on the sea, have grown into considerable villages.

Deer Island, which is separated from Point Shirley, in the town of Winthrop, by Shirley Gut, and which, in 1634, when it came into the possession of the town of Boston, was used as a pound for stray cows and other animals, and was covered with a heavy growth of timber, is now the location of a house of industry, reform school, and hospital, and contains a population of nearly 2 500, of whom 2 050 are inmates of the house of industry, and 340 are boys in the reform school.

Mr. Iardella closed field operations October 20. The statistics of his season's work are as follows:

Topography:

Area surveyed in square statute miles	12
Length of general coast line in statute miles	21·5
Length of shore line of rivers in statute miles	6·6
Length of roads in statute miles	8·3

Topographic resurvey of Boston Harbor; resumption of work in the spring of 1894.—In order to complete the resurvey as soon as practicable, five topographic parties were sent into the field in June. Assistant H. L. Whiting was directed to exercise general supervision of the work, and the chiefs of parties were instructed to consult freely with him in regard to limits of work and other details, so as to secure uniformity in reference to mapping topographic features. Seven projections, each on a scale of 1–10 000, were prepared at the Office to cover the area included in the proposed resurvey. Assistant Herbert G. Ogden began the survey of the section assigned to him in the neighborhood of Cohasset on June 14, and by the close of the month he had completed the necessary plane-table determination of points and had made some progress in mapping the shore line and the outlying ledges and topographic detail along shore, as shown by the following statistics:

Area surveyed in square statute miles	0·8
Length of general coast line in statute miles	6·6
Length of roads in statute miles	3

Assistant R. M. Bache reached Quincy, Massachusetts, on June 26, and began the erection of signals.

Assistant C. H. Boyd began field work on June 15, at Neponset River, the southern limit of the sheet assigned to him.

The statistics of the work accomplished by him at the close of the month, are as follows:

Area surveyed in square statute miles	1·8
Length of shore line of rivers in statute miles	6·5
Length of shore line of creeks in statute miles	3·5
Length of roads	4·5

Assistant O. H. Tittmann, finding that most of the old triangulation stations included within the area of his sheet were gone, was kindly furnished by the Massachusetts State Topographical Survey with a number of geographical positions. Such other points as were required he determined trigonometrically with sufficient accuracy for topographic purposes between June 15, the date on which he commenced work, and the close of the fiscal year and made them the basis of the topography which he began near the Point of Pines west of the Saugus River.

Statistics as furnished by Assistant Tittmann are appended:

Triangulation:	
Geographical positions determined	9
Topography:	
Area surveyed in square statute miles	1·3
Length of shore line in statute miles	3·7
Length of roads and railroads in statute miles	8

That portion of the topographic resurvey of Boston Bay and Harbor assigned to Assistant W. Irving Vinal included the cities of Chelsea, Malden, Medford, Somerville, Everett, and Revere. Mr. Vinal took the field June 13, and at the close of the fiscal year was carrying the work steadily forward.

He has submitted a sketch showing the progress made to June 30, and statistics of his survey up to that date, as follows:

Topography (scale 1–10 000):	
Area surveyed in square statute miles	1
Length of shore line of rivers in statute miles	3
Length of shore line of creeks (including ditches) in statute miles	2·2
Length of roads (including streets and railroads) in statute miles	6·1

Further progress will be stated in the next annual report.

Completion of the main portion of the hydrographic resurvey of Boston Harbor.—The advance toward completion of the main portion of the hydrographic resurvey of Boston Harbor, up to June 30, 1893, by the party in charge of Lieut. W. F. Low, U. S. N., Assistant Coast and Geodetic Survey, commanding the schooner *Eagre*, was referred to in the last annual report.

At the end of the season, November 29, 1893, the work upon projections Nos. 1, 2, 3, 5, and 9 had been completed, and also many small areas of detached soundings on projection No. 4, all of these sheets being on a scale of 1–10 000. Upon projection No. 9, the lone rock, lying about 400 metres southwest of Harding's Ledge Beacon, was only approximately located, the unusually stormy season making it impossible for a boat to approach its vicinity during the time set apart for its further development.

Lieutenant Low has submitted with his season's report a full descriptive report for deposit in the archives with his hydrographic sheets, giving concise statements relating to the topics included in the schedule of hydrographic subjects. A blue print accompanies his report, showing the main ship channel and its improvements as proposed in the plan of the

United States Engineers. He has appended, also, copies of the rules and regulations of the harbor master of the city of Boston, of the quarantine regulations in force at the port, and of the laws, rules, and regulations relating to pilotage.

During the season of 1893 the following-named officers were on duty in Lieutenant Low's party: Lieut. C. S. Ripley, U. S. N.; Ensigns C. P. Plunkett, L. H. Chandler, and F. B. Bassett, U. S. N.; Pay Yeoman R. W. Stevens, U. S. N., and Ship's Writer Wm. B. Proctor, U. S. N.

For the season, the following statistics are reported:

Hydrography:

Number of miles (geographical) run in sounding	825
Number of angles measured	12 210
Number of soundings	71 386
Number of tidal stations established	8

Additional soundings for the completion of portions of the hydrographic resurvey of Boston Bay and Harbor.—In order to develop further certain curves of depth in Boston Bay and Harbor, and provide for the completion in all details of hydrography executed in previous seasons, Lieut. W. F. Low, U. S. N., Assistant Coast and Geodetic Survey, commanding the schooner *Eagre*, reorganized his party on board of her early in April, 1894, and began work on the 17th of that month, instructions to that effect having been issued by the Superintendent in March, and supplemented by detailed instructions from the Hydrographic Inspector.

The officers composing his party were as follows: Lieut. C. S. Ripley, U. S. N.; Ensign L. H. Chandler, U. S. N.; Pay Yeoman W. B. Proctor, U. S. N.; and Ship's Writer James Proctor, U. S. N.

Lieutenant Low reports the following statistics of work accomplished by June 30, 1894:

Hydrography:

Number of miles (geographical) run while sounding	142
Number of angles measured	2 828
Number of soundings	9 787

Further progress will be stated in the next annual report.

Town boundary survey and leveling of precision in Massachusetts.—Assistant Henry L. Whiting served as chairman of the Massachusetts State Survey Commission. Assistant C. H. Van Orden was given general supervision of the field work of the Town Boundary Survey, and at the beginning of the fiscal year he was engaged in running a line of levels between Boston and Albany. At Springfield, Massachusetts, this line connected with the United States Engineer's bench, which is referred to mean tide of Long Island Sound. He connected his line with Perry's Peak trigonometric station, and reached Albany early in November. After completing this work Mr. Van Orden was ordered to Washington in connection with experimental leveling, on which he was engaged until the assembling of the Geodetic Conference, in which he took an active part. After the close of the conference he resumed field work in Massachusetts on a scheme of triangulation extending westward from Boston nearly to the Connecticut River Valley. Stations were selected and a number of signals built, and Boston Statehouse and Holt Station were occupied and finished by the close of the fiscal year.

Determinations of relative gravity with half-second pendulums at Boston and Cambridge, Massachusetts, and Ithaca, New York, the base station being at Washington, D. C.—In pursuance of the scheme for obtaining determinations of relative gravity at a number of stations suitably selected throughout the United States, Sub-Assistant G. R. Putnam was instructed to proceed to Boston early in March, 1894, and to swing the half-second pendulums of the Survey at a station there and at one in Cambridge, Massachusetts, and upon the completion of that work to make similar observations at Ithaca, New York. The reference or base station was the one that has been specially fitted up for pendulum work in the basement of the Coast and Geodetic Survey Office, this station having been previously referred to the former base station at the Smithsonian Institution. Geographical position: latitude 38° 53′·2 N.; longitude 77° 00′·5 W.; elevation above mean sea level 14 metres.

At Cambridge, Massachusetts, the pendulums were swung in a basement room, north of the foundation of the large equatorial of Harvard College Observatory. Every facility for the conduct of the work was afforded by the Director, Prof. E. C. Pickering, and by other members of the staff of the observatory. For the preliminary arrangements at Cambridge, the Survey is indebted to Prof. John Trowbridge, Director of Jefferson Laboratory, Howard University. The pendulum case was set on a heavy stone doorsill about 10 inches above the floor. The temperature and other conditions were favorable. Geographical position of station: latitude 42° 22′·8; longitude 71° 07′·7 W. of Greenwich; elevation 14 metres.

At Boston, by arrangements made by Prof. A. E. Burton, of the Massachusetts Institute of Technology, and with the permission of Mr. Brigham, architect in charge, the pendulum station was located in the northeast part of the basement of the new addition to the statehouse. The pendulums were swung in a vault 11 by 5 feet, the receiver resting directly on the concrete floor. Valuable information in regard to the location of the station was furnished by Professor Burton and by the students in the special course of the institute in geodesy. Geographical position: latitude 42° 21′·6; longitude 71° 03′·8 W. of Greenwich; elevation 22 metres.

At Ithaca, New York, through the courtesy of Professor Fuertes, Director of the College of Civil Engineering of Cornell University, the pendulums were swung in the metric room in the northeast part of the basement of Lincoln Hall (the civil engineering building). The receiver rested on a pier built especially for the purpose of brick and cement, 20 inches square, 36 inches in the ground and 27 inches above, with concrete foundation. Double walls insured a uniform temperature. Every facility was afforded by Professor Fuertes and others of the faculty. Geographical position: latitude 42° 27′ N.; longitude 76° 29′ W.; elevation 247 metres.

At each of the three stations the pendulums were swung for three days. The apparatus used consisted of the half-second pendulums A^4, A^5, and A^6, with the accompanying receiver, flash apparatus, etc., as described in the Report for 1891, Part II, Appendix No. 15. Some modifications have been made since the date of that description; these pendulums carry an agate plane in their heads and swing upon agate knife edges which are inserted in a heavy brass plate resting on the shelf of the receiver.

Other improvements are described in some detail by Mr. Putnam in his report, as well as the essential modifications which were made in the methods of observation with a view to greater accuracy and convenience of observing. He presents also in his report an elaborate discussion of the observations with a tabulation of the results for the values of gravity at Cambridge, Boston, and Ithaca, as deduced from each of the three pendulums.

Mr. S. B. Tinsley, aid, rendered efficient assistance in the work.

Later in the season, Mr. Putnam took up, under instructions, determinations of relative gravity at Princeton, New Jersey, Philadelphia, Pennsylvania, and Charlottesville, Virginia. These will be adverted to under a separate heading.

Physical hydrography.—Survey of the north shore of Nantucket Island, Massachusetts.—The physical hydrographic survey of the ocean shore of the Island of Nantucket from Great Point to Siasconsett and thence to Smiths Point was completed by Assistant Henry L. Marindin during the season of 1890-'91, and in pursuance of instructions issued June 28, 1893, Mr. Marindin organized his party for the physical survey of the north shore of the island.

Preliminary arrangements for the work were begun July 6, camp was pitched at Pocomo Head, and the survey commenced at Great Point and carried thence along the sound shore of the island southward and westward toward Brant Point at the western entrance to Nantucket Harbor. For soundings, one hundred and seventeen sections were laid out as far as the western end of Coatue Beach, and thence thirty-seven sections were laid out over the bar at the entrance into Nantucket Inner Harbor. These additional cross sections were so distributed as to cover fairly the ground of the bar and channel and furnish a means of comparison for changes in depths since the location of the jetties.

The cross sections were sounded out to 30 feet depth, and levels were taken inland on every other cross section, which averages one for each 397 feet of coast line. All of the sections were connected by double lines of levels run in opposite directions; the tide gauges and bench marks were also connected by these lines of levels. For comparison of tide gauges, and their connection with each other, simultaneous observations of water level were taken at high and low tide.

It was deemed desirable to make a connection with the series of tide observations made by the party of Assistant Henry Mitchell in 1854, and a bench mark established by him in that year on Commercial Wharf (a solid wharf with granite side walls), having been found in an apparently good condition, a connection was made by simultaneous readings of water levels between the tide gauges of Coatue Point (eastern jetty) and one put up on Commercial Wharf near the bench mark. These observations indicated, however, that the mark of 1854 must have settled considerably since that date, and that a reference to some other more permanent bench of that year should be made as opportunity offered. None of the benches established by the Naval hydrographic parties in recent years could be recovered, the piling on which they were placed having been destroyed while the wharves were undergoing repairs.

Field operations were suspended for the season on October 11, and soon after Mr. Marindin reported for office duty in Washington.

Mr. M. Victor Safford served as observer, and Messrs. H. T. Marshall and B. H. Griswold, jr., as recorders from the beginning of the season till about the middle of September; the work was then continued with a reduced force till the time of closing. Mr. Marindin acknowledges his indebtedness to the officers and men of his party for their interest and zeal in pushing the work during the season.

He has submitted with his report a sketch showing the limits of the cross sections sounded out, and presents the following statistics:

Physical Hydrography.

Number of soundings on cross sections	9 031
Number of miles of cross sections staked out	87
Total number of cross sections laid out and sounded	115
Number of angles to determine soundings on cross sections	3 639
Number of miles of beach levels run with Y level	19·7
Number of miles of levels on cross sections	9·2
Number of tide gauges observed	3
Number of bench marks established	7

The results of this survey are shown upon one hydrographic sheet, scale 1–10 000. The length of general coast line surveyed was 8·8 statute miles, and the number of miles (geographical) run in deep-sea sounding was 84·5.

Assistant Marindin was engaged on the discussion of his field observations from the time of reaching the Office until May, when he was instructed to prepare for the resumption of the physical hydrographic survey of the north shore of Nantucket and Marthas Vineyard. Under these instructions Mr. Marindin began field work on June 7. The work of his party for the remainder of the fiscal year consisted in running levels and sounding lines, observing tides, and making a plane-table survey of the new shore line. The progress and results of the work will be given in the next annual report.

Tidal record continued at the automatic gauge station at Fort Adams, Newport Harbor.—The United States Engineer officers stationed at Fort Adams, Newport Harbor, have continued to manifest an active interest in the maintenance of the tidal record from the automatic tide gauge established there March 31, 1892. This gauge has been in successful operation throughout the fiscal year. Mr. David Hamilton has the immediate care of it.

Completion of the topographic survey of the Connecticut River.—In order to insure the completion of the topographic survey of the Connecticut River during the season of 1893, the work was distributed by instructions issued early in June among three parties, the charge of which was assigned to Assistants John W. Donn, Charles H. Boyd, and W. Irving Vinal, respectively.

At the beginning of the fiscal year each of these parties had been in the field about two weeks, and their progress up to June 30, 1893, was adverted to in the last annual report.

Mr. Donn took up plane-table work at the northern limits of Hartford, using for the marginal topography the projections upon which the shore-line survey was made in the summer and autumn of 1891. He carried his survey southward on both sides of the river, the southern limits of his sheet being Taylorsville on the east side of the river and Drumhill on the west. Certain portions of topography upon two other sheets, parts of which had been finished by Messrs. Boyd and Vinal, were then executed by Mr. Donn, these including areas between Middletown and Cromwell on the west side of the river, and between Taylorsville and Portland on the east side.

Mr. Donn has transmitted to the archives the three topographic sheets of his survey, scale of each 1-10 000. The statistics are:

Topography:	
Area surveyed in square statute miles	32
Length of shore line of streams and creeks in statute miles	24·5
Length of shore line of ponds in statute miles	2
Length of roads in statute miles	128
Length of railroads in statute miles	26

Mr. Boyd was not able to begin field work with the plane table until June 28, owing to a prevalence of rainy weather; he then took up his survey near Whitman's Dock, Maromas, about 8 miles below Middletown, his sheet joining on the south and east with the lower sheet of Assistant Vinal. The extreme limits of his projection were completed first so as to take advantage of the longest days. The work progressed without interruption, except for some needed determinations of geographical positions, until the upper limits of the sheet were reached in Middletown and Portland, where a junction was made with the supplementary sheet of Mr. Donn.

Mr. Boyd's work covers about 8 miles of the Connecticut River, and the fringe of topography along its banks was carried back for an average width of about three-fourths of a mile, so as to show the system of roads along each bank and the hills commanding the river. Mr. Boyd observes that the country is much broken and thickly wooded, even the villages being densely shaded with various kinds of trees. Upon the east bank the survey included the towns of Middle Haddam, Cobalt, and Portland; at this last-named town are extensive quarries of brown sandstone, said to be the largest in the United States.

On the west bank the suburb of Middletown, known as South Farms, and separated from it by Pamecha Creek, was surveyed, and, several miles below, the Columbia granite quarry was included; here an inferior quality of granite seems to be extensively worked.

Field operations were closed November 23, and on the 28th Mr. Boyd left for his home under instructions to complete the office work of the season.

He acknowledges the very acceptable service rendered by Messrs. W. A. Clapp and F. M. Graham, who were assigned to his party as rodmen.

The results of his survey are shown on one topographical sheet, scale 1–10 000, the statistics being as follows:

Area surveyed in square statute miles	12·5
Length of shore line of creeks in statute miles	2·5
Length of shore line of ponds in statute miles	2
Length of common roads in statute miles	25
Length of railroads in statute miles	8·5

Mr. Vinal began plane-table work on the 19th of June, having been delayed somewhat by unlooked for obstacles in locating his party at a central point in the working ground. Taking up the topography in the vicinity of Haddam, he completed certain areas upon an unfinished sheet of the preceding season. The work on Haddam Neck was difficult of access, there being no village or other settlement, except an occasional farmhouse, on the east side of the river between East Haddam and Middle Haddam, a distance of about 10 miles, while the roads are extremely hilly and far back from the river. Abandoned properties in this section are not unfrequent, and most of the farms that are occupied are tenanted by Swedes. Since no boats suitable for crossing the river could be found in the vicinity, a boat adapted to the work had to be procured, and the party was often required to walk long distances over rough ground, carrying the entire instrumental outfit, etc., to get to the locality of the day's work.

A junction with the southern border of Mr. Boyd's survey having been made about September 1, Mr. Vinal thereupon transferred his party to Middletown and carried the topography of the river, on its west side, northward from Cromwell depot toward Rocky Hill, in the vicinity of which town, early in November, his survey joined that of Mr. Donn. He then moved his party to South Glastonbury and from this place completed the plane-table work on the east side of the river.

In order to leave no portion of the work unfinished, Mr. Vinal remained in the field until December 13, 1893. During the latter part of the season the weather was at times very cold, with storms of rain and snow.

Messrs. H. S. Williams and J. B. Russell served in the party throughout the season, and by their careful attention to the details of the work contributed much to its success. Messrs. C. L. Parker and K. E. Sommer remained until about the middle of the season, being then obliged to return to their studies. The loss of the experience they had acquired was greatly felt.

The results of the work are shown on three topographic sheets, each on a scale of 1–10 000, about one-fourth of one of these sheets having been surveyed by Mr. Donn.

Following are the statistics:

Topography:	
Area surveyed in square statute miles	17
Length of shore line of creeks and ponds in statute miles	37·8
Length of roads in statute miles (including railroads)	82·7

After disbanding his party, Mr. Vinal returned to duty at the office in Washington.

Topography of the Hudson River.—Under instructions dated June 4, Assistant J. W. Donn resumed the topographic survey along the Hudson River in the vicinity of Newburg, on June 15, and was making satisfactory progress at the end of the fiscal year.

Continuation of the resurvey of the shores of Long Island.—The topographic resurvey of the shores of Long Island to the eastward of Bellport Bay was taken up by Assistant C. T. Iardella who began field work on the 16th of June. Statistics of his work will be given in the next annual report.

Automatic tide gauge and tide indicator maintained in operation at Fort Hamilton, New York Harbor.—The automatic tide gauge and tide indicator established in December, 1892, and in

May, 1893, on the wharf of Fort Hamilton, New York Harbor, by the permission of the commanding officer of the fort, have been kept in successful operation during the fiscal year. The tide indicator is an automatic device for enabling mariners while passing through the Narrows to ascertain whether the tide is rising or falling and its height at any time.

A full description with drawing of the tide indicator was published in Notice to Mariners No. 177, for February, 1894.

The gauge and indicator have been in charge of Mr. J. G. Spaulding throughout the year.

Continuation of the tidal record at the automatic gauge station on Willets Point, Long Island, New York.—The automatic tide gauge established July 1, 1891, at Willets Point, Long Island, New York, has been kept in successful operation by the kind supervision of officers of the Corps of Engineers, United States Army, stationed at that point.

The record has been complete throughout the fiscal year. The observers were Lieutenants Herbert Deakyne and M. L. Walker, United States Army.

Determinations of relative gravity at Charlottesville, Virginia; at Princeton, New Jersey, and at Philadelphia, Pennsylvania.—Reference will be found under a preceding heading to the determinations of relative gravity made in March, 1894, at Boston and Cambridge, Massachusetts, and at Ithaca, New York, by Sub-Assistant G. R. Putnam, these determinations having been referred to the base station at Washington, D. C.

During the month of May, Mr. Putnam occupied under instructions and in the order named, three additional stations: Charlottesville, Virginia; Princeton, New Jersey, and Philadelphia, Pennsylvania.

At Charlottesville, by permission of Prof. A. H. Tuttle, of the University of Virginia, a station was occupied in the basement of the biological laboratory of the university, the receiver being mounted on a small brick pier. Much assistance in making preliminary arrangements was rendered by Professors Smith, Tuttle, and Stone, and by Mr. W. B. Tuttle. Geographical position: latitude 38° 02′·1 N.; longitude 78° 30′·3 W. of Greenwich; elevation 166 metres.

Owing to unfavorable weather, which interfered with the observations for time, the pendulum swings had to be continued for five days at this station.

The method of using the half-second pendulums was still further modified at Charlottesville and at the two stations immediately following it. An improved portable air pump having been devised by Mr. E. G. Fischer, chief mechanician of the Survey, by means of which it is possible to exhaust the air from the receiver to less than one-tenth of an atmosphere in about a minute and a half, it was decided to adopt a standard pressure represented by 60 millimetres of mercury reduced to 0° C., and also to lengthen the swings to eight hours, which at this low pressure could be done with ease.

This improvement, besides diminishing the labor of observing and obviating the necessity of much night work, further made it possible to dispense with the barometer and the manometer tube on the outside of the receiver, a small manometer hanging inside taking the place of the latter. It was decided also to make but one swing of each pendulum in each position, making six swings in all, covering forty-eight hours.

The observations for time were made by Mr. H. Y. Benedict, using the transit instrument at the McCormick Observatory under the direction of Prof. Ormond Stone.

At Princeton, New Jersey, the apparatus was set up in the basement of the magnetic observatory (or electrical building) of the College of New Jersey by permission of Prof. C. F. Brackett, to whom as well as to Professors C. A. Young and Taylor Reed, Mr. Putnam expresses his indebtedness for many facilities furnished. The pendulum received was mounted on a tall brick pier in the northeast corner of the room. Position: latitude 40° 21′·0 N.; longitude 74° 39′·4 W.; elevation 64 metres. For determining time Professor Young kindly placed at Mr. Putnam's disposal the Fauth transit in the observatory. Cloudy weather made it necessary to remain six days at this station.

At Philadelphia, through the kindness of Prof. G. F. Barker, of the University of Pennsylvania, a basement room in the northwest corner of College Hall was set apart for the work and every convenience was furnished by Professor Barker, Professor Goodspeed, and the authorities of the university. The receiver was placed directly on the concrete floor and the required observations were completed in two days. Geographical position: latitude 39° 57'·1 N.; longitude 75° 11'·6.; elevation 16 metres.

Both before and after the occupation of these three stations as well as the three before reported the pendulums were swung at the base station in the basement of the Coast and Geodetic Survey Office, Washington.

Geodetic operations.—Occupation of stations in southwestern New Jersey for the extension of the triangulation of the State toward the Delaware River.—Reference was made in the last annual report to the resumption of geodetic operations in southwestern New Jersey by Prof. E. A. Bowser, acting under instructions bearing date of June 9, 1893. Having taken the field soon after June 20, as therein directed, Professor Bowser completed all preparations needed for the occupation of his first station, Pine Hill, by July 6, when observations were begun, the theodolite being mounted on an observing tripod 32 feet high. This station is about 14¼ miles in a southeasterly direction from the City Hall, Philadelphia, and connects with the following-named stations of the primary triangulation in New Jersey: Mount Holly, Berlin, Williamstown, and Taylors.

Observations having been finished at Pine Hill on August 2, Professor Bowser moved to Station Lippincott, a point about 2 miles in a southerly direction from Swedesboro, Gloucester County. To obtain clear lines of sight to stations Burden and Taylors over tall timber, an observing tripod and scaffold 32 feet in height was built at Lippincott, and after signals had been erected at Colsons and Burden, and the one at Taylors readjusted, the measurement of horizontal angles at Lippincott was begun August 16. On the completion of these measurements, September 12, field work was suspended for the season.

Before leaving the field, Professor Bowser marked permanently the station at Burden by a granite monument, 4·5 feet long, dressed 6 inches square at one end for a length of 6 inches, and had the letters "U. S." cut on each of the four sides, and a triangle on the top. This monument was set in hydraulic cement to within 6 inches of its top, and its center is believed to coincide very closely with the position of Mr. Hassler's station, Burden of 1843, two pieces of the old stoneware cone having been found in the hole dug for the monument, and its geodetic position differing but very slightly from that of Mr. Hassler.

Professor Bowser has submitted with his report a sketch showing the near approach of the triangulation in the southwestern part of the State to a connection with the old primary stations in Pennsylvania and Delaware. He reports the following statistics:

Triangulation:

Area of, in square statute miles	700
Number of signal poles erected	7
Number of geographical positions determined	11

In accordance with instructions issued towards the end of March, 1894, field work in southwestern New Jersey was resumed by Professor Bowser early in April. In order to determine the height that would be required for the observing tripods and signals at stations Burden, Bridgeton, and Pine Mount, a reconnaissance was made along the lines Burden–Bridgeton and Burden–Pine Mount, and it was ascertained that with a 64-foot observing signal at each of the stations, Burden and Bridgeton, and with the opening of short vistas through the tree tops on the line, these two stations would be intervisible.

The work of the season will begin as soon as practicable after funds become available by the measurement of horizontal angles at Station Burden.

Details of procedure are arranged by Assistant George A. Fairfield, in immediate charge of State Surveys.

Measurement of a short standard base line for the city of Baltimore.—Application having been made to the Superintendent by Col. H. T. Douglas, chief engineer of the topographic survey of the city of Baltimore, for the measurement of a standard base line 500 feet in length, on the outskirts of Baltimore, and for the detail of two officers to conduct the measurement, Assistant D. B. Wainwright was instructed to undertake the work and Sub-Assistant G. R. Putnam was detailed to aid him.

The secondary base apparatus having been forwarded to Baltimore, Messrs. Wainwright and Putnam proceeded thither on the morning of June 20, 1894, and after a conference with Colonel Douglas, he assigned several assistant engineers to aid in the measurement. The line is located on Port Royal avenue about ½ mile northwest from the Pennsylvania Railroad passenger station. This avenue is a boulevard, having the parking in the center, and the line was laid out on the turf of this parking. It was marked by seven granite posts sunk in the ground to within 6 inches of the pyramidal-shaped tops. These posts were placed so as to divide the line into sections of 100 feet each, and one of these sections was subdivided into two of 50 feet each.

On the afternoon of the 20th, all preliminary adjustments of the base apparatus were made; the members of the Baltimore survey were instructed in regard to the assistance they could render, and a run was made over the 100-foot section.

Next day the line was measured twice between 10 a. m. and 6 p. m., though not without some delays, owing partly to the little time available for training the party in handling the apparatus and partly to the intense heat, the thermometer attached to the bars indicating over 102° Fahr. This affected the adjustments of the transit sector, some of its parts being unequally heated; hence the adjustments had to be repeatedly changed.

Mr. Wainwright acknowledges the invaluable aid rendered by Mr. Putnam, and states that the members of the Baltimore topographic survey furnished every assistance in their power.

The field and office computations show that the probable error of measurement is within the required limit.

Telegraphic determination of the difference in the force of gravity between Washington, D. C., and Baltimore, Maryland.—Between July 15 and 31, 1893, a telegraphic determination of the difference in the force of gravity between Washington and Baltimore was made by Assistant E. D. Preston with the aid of Mr. F. A. Wolff.

The pendulums used were three in each set: A^4, A^5, and A^6, and B^1, B^2, B^3. They were of the half-second type and at Washington were swung on the pier in the pendulum room at the Coast and Geodetic Survey Office. At Baltimore, through the kindness of President Gilman and Professor Rowland, of the Johns Hopkins University, a room in the northeast corner of the basement of the physical laboratory of the university was assigned to Mr. Preston, the receiver resting on a solid pier of masonry. The two stations were connected by a wire of the Western Union Telegraph Company, placed at the disposal of the Survey by the courtesy of Mr. M. Mareen, manager at Washington, and Mr. W. T. Bloxam, manager at Baltimore.

The method of work was essentially that described on pp. 528–530 and 563, 564 of the Report for 1891, Part II.

Experimental Leveling in Washington, D. C.—The results of the leveling carried out by Assistant C. H. Van Orden for the Massachusetts State survey, with instruments, and by methods differing essentially from those employed in the precise leveling of this survey, gave such satisfactory results that Mr. Van Orden was directed to proceed to Washington and to employ the same method in running over the test line established here. The final discussion of results of these experimental levels, in comparison with those made by other methods, has not yet been made.

During January and February Mr. Van Orden was in attendance on the meetings of the Geodetic Conference.

Record continued from the automatic tide gauge at the station at the Washington Navy-Yard.—A continuous record has been obtained for the fiscal year from the automatic tide gauge established in July, 1891, at the Washington Navy-Yard.

The gauge has been kept in operation by members of the Tidal Division of the Office, Assistant George A. Fairfield, chief of the division.

Survey of the Outer Diamond Shoal, off Cape Hatteras, for the use of the Light-House Board.—The Light-House Board having requested the Superintendent to have a survey made of the Outer Diamond Shoal off Cape Hatteras, North Carolina, for the purpose of locating the positions at which borings ought to be made on the site of the light station proposed to be erected on that shoal, instructions were issued April 12, 1894, to Lieut. L. M. Garrett, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *Endeavor*, to proceed to Cape Hatteras and execute the survey required.

The *Endeavor* arrived at Hatteras Inlet April 18, and began work as soon as the necessary projections and data were received from the Office, some delay having been caused by the poor postal facilities. Search was made for the old triangulation station, King's Point, and this having been recovered, a 30-foot pole tripod was erected over it. With this and Hatteras Light as a base, the points needed for the survey were determined. Checks were obtained on these positions by angles from the vessels off shore, using Oliver Reef Light as one object and the foremast of the steamer *Wetherbee*, wrecked on the shoals, as another.

Although all was in readiness to begin soundings on April 27, the weather continued so windy and the sea so rough that it was not until May 5 that they could be obtained. On the 4th a tide staff was set up just inside of the inlet, high and low waters being observed whenever the weather allowed, and continuous readings taken while soundings were in progress.

By May 16 enough lines had been run over the shoal to develop the depths needed, and on that morning the light-house tender *Maple* was reported off the coast. She was met by Lieutenant Garrett between the shoals and the inlet. Capt. Yates Stirling, U. S. N., Inspector of the Fifth Light-House District, came on board the *Endeavor*, and both vessels steamed back to the shoals to drop the marking buoys at the localities where borings were to be made.

Captain Stirling informed Lieutenant Garrett that the apparatus to be used in boring drew 21 feet of water; it was concluded, therefore, that the only available point was one of those that had been selected on the outer edge of the outer lump. The *Endeavor* then steamed slowly up to this from the southeast until 21 feet of water was found with the lead; she then anchored. A small marker buoy was dropped, and Lieutenant Garrett requested Captain Stirling to place the first nun buoy some 20 or 30 metres to the southeast of the marker.

The *Endeavor* then steamed to the southwest and dropped the second marker in 21 feet of water, distant about 60 metres southwest of the first one. The *Maple* having dropped its buoys as requested, the work undertaken by Lieutenant Garrett was completed, and he proceeded in his ship to Hampton Roads, where he made a tracing of the shoals with positions of buoys marked, and mailed it to Mr. Julius E. Rettig, superintendent of construction under the direction of the Light-House Board.

Topographic survey of the Cooper, Ashley, and Wando rivers, vicinity of Charleston, South Carolina.—In accordance with instructions issued January 20, 1894, Assistants John W. Donn and C. H. Boyd proceeded to Charleston, South Carolina, and organized cooperating parties for the survey of the topography of the Cooper, Ashley, and Wando rivers in that vicinity.

It was provided in their instructions that the shore lines of the several rivers were to be first carefully delineated for the use of the hydrographic party in charge of Lieut. Robert G. Peck, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *Bache*. While the shore line survey was in progress, Messrs. Donn and Boyd were assigned to quarters on board the *Bache*, and both of these officers express their acknowledgments for the very cordial support received from Lieutenant Peck and from Ensigns Oman and Cline. Their stay on the steamer lasted from January 24 to March 6. The shore-line survey having then been completed they made arrangements for living on shore.

The cooperation of the two plane-table parties was made very close and systematic, so that not an hour was unavoidably lost in preparing the ground for the work that was to follow. Mr. Donn ran the shore line of the east side of Wando River and a part of the west side to a junction with the work of Mr. Boyd; he then surveyed the shores of the Cooper River and its principal creeks and bayous. The survey of the Ashley was advanced in like manner.

Mr. Boyd searched for and recovered sixteen of the stations of the old triangulation and at two of the points from which the station marks had disappeared he determined plane-table points, and erected in all eighteen second-order tripods. He observes that after leaving the *Bache* the work was carried on either with a hired launch or by the aid of teams, the topography being filled in back from the shore line on both sides of the Ashley and Cooper rivers and on the Charleston Peninsula, and that practically there are two lines which may be classed as shore line—that between the river and the marsh, as defined by the grass line, and the line of fast land between the soft marsh and the upland. This latter is covered with trees and shrubbery, is more tortuous than the former and exceeds it in length. The first-named line is that counted in the statistics.

In order to insure the completion of the entire area of topography included in the projections, Assistant W. C. Hodgkins was instructed to proceed to Charleston and consult with Messrs. Donn and Boyd in regard to the execution of the work remaining to be done March 1. This was the interior topography of the Wando and Cooper Peninsula, and it was completed by Mr. Hodgkins between March 3 and April 19. For transportation of his party he had a naphtha launch; the parties of Messrs. Donn and Boyd had a Daimler motor launch. During the week before the completion of their survey land transportation became necessary because the interior portions of Charleston Neck could not be reached by any other method. They closed field operations April 14–15.

The statistics reported are as follows:

Topography.

	Mr. Donn.	Mr. Boyd.	Mr. Hodgkins.	Totals.
Area surveyed in square statute miles	18	15	11	44
Length of shore line of rivers in statute miles	51·8	30	58·7	140·5
Length of shore line of creeks in statute miles	16	22	53	91
Length of roads in statute miles	48·7	27	37	112·7
Length of railroads in statute miles	27	8	--	35

The three topographic sheets completed were each on a scale of 1–10 000.

Hydrographic survey of the Ashley, Cooper, and Wando rivers, South Carolina.—Under instructions from the Superintendent, bearing date of January 26, 1894, and detailed instructions of January 12 from the hydrographic inspector, the steamer *Bache* was prepared for sea and placed under command of Lieut. Robert G. Peck, U. S. N., Assistant Coast and Geodetic Survey, with orders to proceed to Charleston, South Carolina, and execute the hydrography of the Cooper, Ashley, and Wando rivers to the limits of the completed triangulation.

The *Bache* left Hampton Roads January 22, and arrived at Charleston on the 24th. Immediately upon her arrival Assistants Donn and Boyd, as stated under the preceding heading, came on board and were assigned quarters by Lieutenant Peck, it having been arranged that their stay should continue until they had finished the determination of points and the delineation of the shore line needed for the hydrographic survey.

This work was laid out upon four projections, each upon a scale of 1–10 000; Nos. 1 and 2 including about 12 miles of the Ashley River; No. 3 about 8 miles of the Cooper River northward from its junction with the Wando, and No. 4 about 4 miles of the Wando from its junction with the Cooper.

Work was begun in the Cooper River January 30, and from that time until March 6 consisted in recovering the triangulation points, erecting the tripods and hydrographic signals, locating the latter, and putting in topography of shore line. In this service two whaleboats of the ship were uninterruptedly employed with crews, a naval officer and a recorder in each, in addition to the civilian assistant, thus practically utilizing the entire force of the vessel. The ship herself was constantly moved about so as to be kept in the immediate vicinity of the boats, and these arrangements were found to be very efficient, economical, and satisfactory.

Upon the departure of the topographers, Lieutenant Peck transferred the shore line and points from their sheets to his projections without delay, and began the hydrography of the Ashley River, taking first this narrower and more intricate stream in order to finish it before the coming of warm weather should make a stay in the vicinity of its marshy banks dangerous to the health of the party.

The hydrography of the Cooper and of the Wando followed in the order named.

In the execution of the work one system of lines was planned perpendicular to the axis of the stream (normals), and this system was intersected at right angles by a second or check system (longitudinals) following its general direction. In the broader parts of the rivers the normals were spaced at intervals of 150 metres, and the longitudinals at somewhat variable intervals with the variable widths of the streams. The number of longitudinals was never less than three, and the intervals never more than 200 metres. The cases of special development, which were numerous in the Ashley, were as a rule prosecuted in connection with the general system by doubling the number of lines. From the beginning of Cowhead Reach to Lambs (covered by projection No. 2) the stream becomes much narrower, and the intervals between the normals were accordingly reduced to 100 metres.

This part of the river Lieutenant Peck found to be so full of shoals, and its navigable channels so narrow, that he decided later to return and double its development by running lines alternating with those of the first set, thus making the intervals between the normals but 50 metres. What further induced him to make a very close survey in this locality was the fact that owing to the washings from the works where the phosphate is crushed and made ready for market the shoals are constantly increasing in extent and the depth of water constantly decreasing. In this way the navigation of the river has already become considerably obstructed, and should the same conditions continue, it would seem to be only a question of time when the Ashley would cease to be a navigable stream.

This danger has been recognized by the Charleston Mining and Manufacturing Company, which is much the largest establishment of the kind on the river, and it has discontinued the practice of tailing the washings into the river and now deposits this waste material upon the land. Very extensive works for this company have recently been built at Fetteressa, 3 miles farther down the river and below the worst of the shoals, and the old works are soon to be entirely abandoned. The close development of this part of the river was very heartily commended by Capt. F. V. Abbot, United States Engineers, in charge of improvements in Charleston Harbor. He regards it as of great value for purposes of comparison when future surveys may have become necessary.

Lieutenant Peck observes that the commercial interests located on the river above Lambs, where the survey of the *Bache* terminated, are of considerable importance and consist of several phosphate mining establishments and one set of fertilizer manufacturing works. At the former, the phosphate rock is mined, crushed, washed, and dried; at the latter, the rock thus prepared is pulverized, treated with sulphuric acid, and mixed with potash and other ingredients, and is thus manufactured into a commercial fertilizer.

In the Cooper River, above the limit of the hydrographic survey, there are no commercial interests of great importance, the navigation being confined chiefly to small schooners, sloops, and boats engaged entirely in domestic trade. Inasmuch as the stream is reported to be easy of navigation as far as Strawberry Ferry, some 20 miles above the limit of the hydrography, and since 15 feet at high water can be carried to that point, Lieutenant Peck deems it of sufficient importance to merit an extension of the survey to the point named.

The survey of the Wando River terminated at a point where it was still a fine broad stream. The village of Cainhoy is situated on the right bank of the Wando several miles above the limit of the hydrography, and a small steamer makes a daily trip between Cainhoy and Charleston.

Considerations advanced by Lieutenant Peck in his report in favor of a resurvey of the area included between the jetties, and for carrying this resurvey out to the 5-fathom curve and to such distance northward and southward of the jetties as may be convenient, will have much weight when the question of executing a survey entirely independent of that made by the United States Engineers comes up for decision.

He observes that he found the views of Captain Abbot respecting further surveys to be entirely in harmony with his own, and he expresses his indebtedness to that officer for his readiness to assist in every way in forwarding the hydrographic work.

Upon the completion of the survey, May 8, 1894, the *Bache* left Charleston for New York.

Following are the statistics for the season:

Hydrography:

Area sounded in square geographical miles	11
Number of miles (geographical) run in sounding	305·1
Number of angles measured	7 129
Number of soundings	31 095
Number of tidal stations established	8

Lieut. W. S. Benson, U. S. N., and Ensigns G. W. Kline and J. W. Oman, U. S. N., were attached to the party on the *Bache* and rendered acceptable service as observers.

Hydrographic resurvey of St. Simons Bar, off the entrance to St. Simons Sound, Georgia.—The duty of making a complete resurvey of the bar about 4 miles to the southeast of the entrance to St. Simons Sound and of the channels across it was entrusted to Lieut. L. M. Garrett, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *Endeavor*, by instructions issued early in January, 1894.

Leaving Baltimore January 5, the *Endeavor* arrived at Brunswick, Georgia, on the 13th of the same month, and search for triangulation points was at once begun. Considerable difficulty was experienced in recovering any of the old triangulation stations of 1857 to 1860, but on January 17 Station Mud was found, and this, with St. Simons and St. Andrews light-houses, gave the necessary bases. The work of building and cutting in signals was then begun, and had been advanced far enough to commence the sounding lines by the 5th of February.

Lieutenant Garrett observes that all of the station marks on or near the seacoast in the vicinity of his work have entirely disappeared with the lapse of time, and because of the heavy storms which do so much damage along the coast. Two marble station marks, inscribed "U. S. C. S.," and having the usual cross lines, were picked up on the beach and left at St. Simons light-house.

On the wharf, near this light-house, a tide gauge was set up January 22, and observations were kept up for two full months, high and low waters being recorded day and night, and staff readings taken every ten minutes on days when sounding was in progress. The results were found to agree very closely with those of the six months' series from the self-registering gauge of Capt. O. M. Carter, United States Engineers. Lieutenant Garrett acknowledges the receipt of many courtesies and offers of assistance from this officer.

Much foggy and smoky weather prevailed in February, only two entire working days, with parts of eight others, being available during the month. Three of the calm smoky days were utilized in tide observations at a temporary gauge which had been pumped down on the bar, simultaneous readings being taken at this gauge and at the permanent one near the light-house. Their results, as plotted, do not seem to indicate any difference in range, but from ten to thirty minutes in time depending upon the amount of rise and fall.

The detailed instructions to run lines of soundings at intervals of 100 metres were carried out as near as the conditions permitted in the immediate vicinity of the bar and channel. Outside and around this, for a space of about 9 square miles, the lines are not so closely spaced, but are believed to be enough to develop the curves and show the nonexistence of other clear channels.

The tidal currents set fair with the buoyed channel and with the one leading out to the southward of the south breakers. Their greatest velocity is about two knots at spring tides, and the current runs at times an hour after the stand; that is, the flood current continues to run after high water, and the ebb after low water.

Lieutenant Garrett has submitted a full descriptive report to accompany his hydrographic sheet. This report covers nearly all of the topics outlined in the circular of July 8, 1890, and in addition thereto embodies much information of value derived from local inquiries.

He acknowledges most cheerful and able cooperation in the survey rendered by the officers under his command: Ensigns J. J. Blandin and C. P. Plunkett, U. S. N.; Pay Yeoman C. L. Green, and Ship's Writer Eugene Veith, U. S. N.

The statistics of the work, which was finished March 22, 1894, are as follows:

Hydrography (scale 1–20 000):

Area sounded in square geographical miles	9
Number of miles (geographical) run while sounding	314·8
Number of angles measured	2 808
Number of soundings	17 731

After sending the records of the St. Simons survey to the Office, Lieutenant Garrett was instructed to proceed to Savannah entrance and make a hydrographic examination of the river and approaches.

Hydrographic examinations in the Savannah River, and in Tybee Roads, Georgia.—A very extensive system of jetties, wing dams, training walls, etc., being in process of construction in the Savannah River under the direction of the United States Engineer Corps, Lieut. L. M. Garrett, U. S. N., Assistant Coast and Geodetic Survey, was instructed to make such hydrographic examinations in that river and in Tybee Roads as would serve to develop the new channels, and locate correctly the aids to navigation.

Proceeding to Savannah with his party on board the steamer *Endeavor* early in April, 1894, he began a search for points of the old triangulation, and readily recovered a sufficient number to determine the positions of all the beacons, buoys, etc., from the city down to the sea. Some of these points were tall brick chimneys standing by themselves, and admirably adapted for use as signals in the hydrography.

Lieutenant Garrett found that for the prosecution of the improvements, Capt. O. M. Carter, United States Engineers, the officer in charge, had established a chain of triangulation stations at frequent intervals, resting upon a measured base in close proximity to the Coast and Geodetic Survey base, this system having been connected with the triangulation of the survey near the base line and again at Tybee Light.

A goodly number of these theodolite stations Lieutenant Garrett thought it advisable to determine in position and plot on his projections, marking them with the letters "U. S. E.," so that in future but little difficulty would be found in making use of the engineer surveys for purposes of comparison or otherwise.

His triangulation was carried down the river by Ensigns John J. Blandin and C. P. Plunkett, U. S. N., and completed April 12. On the following day Lieutenant Garrett ran a few lines across the bar off Tybee in order to ascertain what changes had taken place there since former surveys, and also the advisability of a resurvey. The reduction for tide was obtained from the staff of the self-registering gauge of the United States Engineers on the wharf near Fort Pulaski, the zero of which is set at mean low water. Fifteen minutes difference in time was assumed to reduce to the bar.

Remarkably little change was found on the bar except in the swash channel. Corrected positions of the buoys were obtained for insertion on the chart.

Lieutenant Garrett has submitted a descriptive report of his survey for file in the archives with his hydrographic sheet. From Savannah he proceeded to Hatteras Inlet to make the survey for the use of the Light-House Board which is reported under a preceding heading.

Lines of leveling of precision run across the peninsula of Florida between St. Augustine and Cedar Keys.—Under instructions dated February 28, 1894, Assistant Isaac Winston proceeded to Florida, and on March 13 began at Palatka a simultaneous double line of leveling of precision which he carried to St. Augustine. He then moved his party to Cedar Keys and carried a similar line from Cedar Keys to Palatka. The total length of line was 216 kilometres.

Advantage was taken of this service and of Mr. Winston's experience as an observer in geodetic leveling to test the method of observing and the instruments used by Assistant Van Orden on the line of precise levels between Boston and Albany, as explained in the report of the commissioners of the topographical survey of Massachusetts to the governor, 1893. Mr. Winston was fortunate in securing the services of Mr. Van Loan who had been Mr. Van Orden's bubble tender on the Boston and Albany line; hence with the exception of the change of observers the work was done under the same conditions. In some details improvements were made; a better and more sensitive level vial was substituted for the one on the instrument; a central white band across the target 0·01 foot wide was employed with its lower edge opposite the zero of the target, thus rendering all corrections to the rod reading additive; the form of record was changed so that the observed correction and rod reading are shown instead of the corrected rod reading only, as in the Massachusetts work; the micrometer screw was set each time to the horizon reading so that it was possible to level the instrument by using the long sensitive level instead of the two levels at right angles for rough leveling; the screws clamping the tripod legs to the instrument were loosened each time before moving, and clamped again after placing the tripod in position at the next station so as to secure a more stable condition; the instrument was covered with a white rubber cloth cover while being carried from station to station, and it was shaded during the observations with a large umbrella.

The computation was made after determining the difference of level between two successive bench marks, thus rendering the observations more free from bias than is possible when the work is computed station by station with constant comparison of the two lines made as each successive height of the instrument is obtained.

The nature of the country, and the sand ballast used as the roadbed of the railroad rendered the use of plates to support the rod necessary, and a brass boss was placed on the bottom of the rods so that they could be used with the plates already in use on the precise leveling work of the Survey. In many places the plates could not be made stable and pegs driven in the ground were used to support the rods.

The instrument was set up and leveled each time by the observer, who then placed his eye at the telescope, and the bubble tender having brought the bubble to the center, he then gave a signal to the observer who at once estimated the position of the observing wire on the central white band of the target which had previously been placed in position and clamped.

Mr. Winston expresses views adverse to the employment of a bubble tender, the conditions under which he is compelled to work and his contiguity to the observer and to the instrument being, in his judgment, not favorable for obtaining good observations.

The route followed was the same as the route of the precise level lines of 1892 and 1893, and the same permanent bench marks were used, thus affording frequent comparisons. One line was run with rod 1, and the other with rod 2, the order of observing adhered to being: backsight on 1, backsight on 2, foresight on 1, and foresight on 2.

An examination of the difference in height of the rods in each position as determined by the foresight and again by the backsight showed that large discrepancies between the two lines from one bench mark to another may be caused by small partial discrepancies which accumulate, and small discrepancies result from large partial discrepancies which balance.

Mr. Winston states that while with the instruments and methods employed during the season of 1894, the progress was far more rapid, the cost much less, the labor very much lighter, and the computation easily and quickly made, these advantages do not make up for loss of accuracy in results as compared with the geodetic leveling of the Survey. Field operations were closed May 1. Mr. S. M. Van Loan rendered faithful and acceptable service throughout the season. Mr. A. B. Turner served efficiently as rodman.

Completion of special service at Chicago in connection with the World's Columbian Exposition.—Location in geographical position of light-houses on the Atlantic Coast and hydrographic surveys on the coasts of Florida and Louisiana.—Reference was made in the last annual report to the transfer of the Coast and Geodetic Survey steamer *Blake*, under the command of Lieut. G. W. Mentz, U. S. N., Assistant Coast and Geodetic Survey, from the Atlantic Coast to Chicago, and to the exhibit made on board of her of apparatus and instruments used in deep-sea sounding and in observations of currents, this being part of the Coast and Geodetic Survey exhibit at the World's Columbian Exposition.

On July 7, 1893, in compliance with a request from the Director-General of the Exposition, Lieutenant Mentz assisted in the reception of the Columbian caravels, the *Blake* having been assigned to a position as leader of the left column of vessels, and taking part in all of the movements and ceremonies of the day. These services met with a cordial acknowledgment from the authorities of the Exposition.

On July 12, the *Blake* assisted in the reception of the *Viking*.

In accordance with instructions, Lieutenant Mentz with his ship left Chicago, October 15, and arrived at St. Andrews, New Brunswick, November 2. Proceeding thence to Boston and New York, he arrived at the latter port November 13, having located in position, en route, the light-vessels in Vineyard and Nantucket sounds.

Leaving New York November 20, he proceeded to Baltimore, and while en route located light-vessels and investigated the 3½-fathom patch in the vicinity of the Winter Quarter Light-ship.

Later in the season, the *Blake* was in service on the coasts of Florida and Louisiana, reports of which will be found in geographical order in the Eastern Division.

Lieutenant Mentz has reported the following statistics of his work during the fiscal year:

Hydrography:	
Area sounded in square geographical miles	79
Number of miles (geographical) run while sounding	776
Number of angles measured	6 003
Number of soundings	51 591
Number of hydrographic sheets finished, 4	1 of 1–10 000 1 of 1–80 000 2 of 1–20 000

Hydrographic examination of St. Lucie Inlet, east coast of Florida.—A new opening having been formed at St. Lucie Inlet, about 14 miles to the northward of Jupiter Light, east coast of Florida, Lieut. G. W. Mentz, U. S. N., Assistant Coast and Geodetic Survey, was instructed to stop there with his party on board the steamer *Blake* while en route to Pensacola, and make such determinations of position and examination of depths, channel ways, etc., as would furnish data for locating the inlet on the charts.

On reaching the inlet January 29, the weather was too unfavorable to admit of successful work; the survey was postponed, therefore, till the *Blake* could stop on her way northward in the spring.

On May 16 Lieutenant Mentz detailed Lieut. Charles S. Ripley, U. S. N., to make the examination required, and has appended Lieutenant Ripley's report to his own.

Two of the stations of the Survey, Refuge and Dr. Baker's house, the geographical positions of which were known, were recovered, and from the line connecting them as a base, other points were established and the inlet located.

Lieutenant Ripley reports that 5 feet of water may be carried into the Santa Lucia River through this inlet by using the north channel. That the south channel is the deepest and widest, but it shoals to 4½ feet off Long Point. From the reef outside about 15 or 16 feet may be carried into and through the mouth of the inlet, shoaling to 8½ feet off the northwest point of Long Island. The outside reef, beginning at the sea beach about 1½ miles north from the inlet, and extending out and down the coast for some distance, is a narrow ledge, and is about one-third of a mile from the shore line opposite the inlet. This reef forms a natural breakwater, and for a distance of about 1⅓ miles along the reef, and opposite the inlet, there is from 7 to 8½ feet of water, with from 3 to 4 fathoms outside.

The reef is narrow and the rocks are of such a formation, broken shells embedded in sandstone and a species of coal, that an opening could easily be cut through, Lieutenant Ripley observes, should the water carried to the Santa Lucia River deepen to 8 or more feet, and thus warrant the cutting of the passage.

The sea breaks over the reef when the wind blows from the eastward.

The inlet has affected the waters of the Santa Lucia River and the creeks emptying into it by changing them from fresh to salt; also the water of the Indian River in the vicinity. Before the opening of the inlet the Indian River was full of manatee grass, through which small steamers and boats found it difficult to navigate. This grass has completely disappeared, not a trace of it being left.

At the time of the survey the mouth of the inlet was found to be about 400 metres in width.

Many other details of interest to the navigator are given in the reports of Lieutenants Mentz and Ripley.

The records of the work have all been forwarded to the Office. Upon its completion, May 25, the *Blake* proceeded to New York.

Hydrographic survey of Pensacola Bay, Florida.—Early in February, 1894, Lieut. G. W. Mentz, U. S. N., Assistant United States Coast and Geodetic Survey, commanding the steamer *Blake*, arrived at Pensacola, under instructions to make a resurvey of the vicinity of that port and its approaches.

On the 7th of that month he took up the preliminary work of the hydrography of that part of the bay between the village of Woolsey and Bayou Texar. Within these limits is included a fine harbor of great extent, about 25 miles square, completely landlocked, and affording good anchorage for a numerous fleet of vessels. More than 30 feet of water can be carried to the town of Pensacola in this part of the bay, and Lieutenant Mentz observes that it is to be regretted that the entrance will not admit of a greater draft than about 21 feet at low water.

Several days were occupied in recovering triangulation points, erecting signals, establishing bench marks, etc., and on February 15 soundings were begun and continued whenever the weather and other circumstances would permit until the work was completed, May 11.

A plane of reference of the soundings was obtained by tidal observations made day and night between February 14 and March 17; after the last named date the tides were observed only when soundings were taken.

For the soundings, lines about 150 metres apart were run normal to the general direction of the shore line; these were intersected by lines at right angles to them, and at about the same distance apart. About the docks at Pensacola City the lines were run about half that distance apart. The shoal off Town Point was specially developed, as was also the channel leading to Muscogee Wharf. The deepest water was found at the western end of the hydrographic sheet in the vicinity of Woolsey.

Lieutenant Mentz commends the hearty support given him by the officers of his party: Lieutenants J. A. Shearman and C. S. Ripley, U. S. N.; Ensign F. B. Bassett, U. S. N.; Passed Assistant Engineer K. McAlpine, U. S. N.; and Assistant Surgeon J. A. Guthrie, U. S. N.

The statistics are:

Hydrography (scale 1-10 000):

Area sounded in square geographical miles	497
Number of miles (geographical) run while sounding	5 870
Number of soundings	47 772
Number of specimens of bottom preserved	36

Hydrographic survey of waters adjacent to Pensacola Bay.—The hydrographic party organized by Lieut. Franklin Swift, U. S. N., Assistant United States Coast and Geodetic Survey, commanding the schooner *Transit*, began the survey of certain tributaries of Pensacola Bay under instructions issued in January, 1894.

The work to be executed was laid out on three projections, each on a scale of 1-10 000, these projections including the Big Lagoon, Escambia Bay, and East River.

The Big Lagoon is a body of water about 6 miles long by 1½ miles wide, extending from just inside the entrance of Pensacola Bay westward to within ¾ mile of the waters adjacent to Perdido Bay. Its entrance is shoal, having but little more than 2 feet at mean low water in the main channel, and there is danger in attempting to enter on account of breakers, except in smooth weather.

Just to the southward of the main channel is another channel in which a little deeper water can be carried, but it is very narrow and tortuous. Every heavy gale is said to alter these channels, as the bottom is composed of sand. Inside, a good channel extends as far as Robertsons Island, where it divides, the best water being in the south channel which passes near the red beacon. Over the north channel, which passes near Robertsons Island, a little over 2 feet at mean low water can be taken. The bottom here is mostly soft mud.

Lieutenant Swift observes that it is probable that with but little expense a water course in which 6 feet could be carried could be constructed from Pensacola Bay through the lagoon to Perdido Bay. Two small jetties at the entrance, with some dredging inside, would be all that could be required. Names of localities on the hydrographic sheet were obtained from Robert Harris, light keeper, who had lived in the neighborhood all of his life.

It was found that the shore line had entirely changed from that shown by the old survey

For the resurvey of Escambia Bay a projection was laid out having as its northern limit the Louisiana and Northwestern Railroad trestle, and for its southern a line from Garcon Point to Emanuel Point. It included a body of water about 5½ miles long by 3 miles wide.

Lieutenant Swift reports that in general more water was found than was shown by the original survey, this being especially true of the water on the oyster reefs. Some new reefs were discovered, one particularly, near the red beacon, where there was found to be only 4 feet at mean low water about 40 yards northeast of the beacon. To the northwest of it, at about the same distance, another shoal spot was found. The shoal off Caheronne Point extended nearly as far to the northeast as was shown on the original survey.

Of the old beacon, nothing remains but a pile of masonry with less than 1 foot over it at mean low water; this being dangerous to navigation, it was marked by a heavy spile, which was worked down with a bush attached to it. This will remain for a long time.

A great menace to navigation in all parts of the bay exists from what are called "dead heads,"—heavy cypress logs, one end sinking into the mud and the other end just awash, their position changing with every heavy wind. The whole bay is surrounded by swamps, and the air is full of malaria.

The principal traffic is the towing of lumber and timber from the upper bay through the draw to Pensacola. The only mill is the cypress shingle mill at Bohemia, and the largest settlement is at Trout Bayou, which forms an excellent harbor for small vessels. At mean low water 2½ feet can be carried in. There is also a good harbor at Indian Bayou with more water.

The people make a living by oystering and fishing. The oysters at Escambia Bay are considered particularly good, and formerly dredging for them was quite a business ; they are now, however, getting more and more scarce. Lately oyster beds have been planted on a line south from Indian Bayou.

East River is a body of water about 3 miles long by ¾ mile wide. It is at the extremity of Maria de Galvaez Bay, and is called by the people living in the vicinity East Bay, the river that empties into it at the eastern end being East River, but the bay, so called, seems to partake more of the nature of a river with its steep-to banks. It is a fine body of water without shoals and is easily entered. The depth continues good up to the eastern end, where it shoals, but there is a channel into the river which is itself deep.

A few houses are scattered along the shores, and the occupation is mostly wood cutting, the wood being carried in small schooners to Pensacola.

The hydrography was carried well out into Maria de Galvaez Bay.

Lieutenant Swift speaks in terms of high praise of the zealous and efficient service rendered by all who were associated with him in his survey. Ensign C. M. McCormick, U. S. N., was the only commissioned officer on the *Transit*. Mr. W. H. De Luce served as recorder, George Steinman as observer, and Otto Plym as leadsman, all with great credit.

For the season, which closed April 28, the statistics are:

Hydrography:

Number of miles (geographical) run while sounding	685
Number of angles measured	8 257
Number of soundings	73 285
Number of tidal stations established	4

Topographic survey of tributaries of Pensacola Bay.—Under instructions of February 26, Assistant P. A. Welker reached Pensacola, Florida, on March 2, and after repairing the naphtha launch, and overhauling the schooner *Quick*, laying in supplies and organizing the party, he reached the immediate locality of his work on March 8. A preliminary triangulation having been made, he began the topographic survey at East River. By April 25, Assistant Welker had finished East River and Blackwater Bay and nearly all of Escambia Bay and East Bay, only a small portion of the two latter and of Pensacola Bay remaining to be surveyed. Up to April 25, the progress of the work had been unusually rapid and successful but on the 26th, the chief of party, the recorder, and two men were simultaneously attacked by malarial fever and field operations had to be suspended.

Assistant Welker recovered on May 6, and after disbanding his party returned to Washington on May 15, but Mr. H. L. Stidham, recorder, whose services are mentioned with high praise by his chief of party was prevented by the severity of his illness from leaving Pensacola until after June 1.

The statistics of the season's work are as follows:

Number of triangulation signals built	4
Number of stations occupied	5
Number of stations occupied for magnetic declination	5
Number of miles of shore line surveyed	49
Number of miles of railroads and other roads surveyed	29
Number of miles of creeks surveyed	30
Number of miles of swamp line surveyed	46
Approximate area in square statute miles	51
Number of topographical sheets finished, scale 1–10 000	5

Completion of a scheme of reconnaissance for primary triangulation in Alabama, whereby data will ultimately be available for the measurement of an oblique arc of the meridian, extending from the northeastern boundary of the United States to the Gulf of Mexico.—Full mention was made in the last annual report of the reconnaissance executed in southern Alabama by Assistant F. W. Perkins, by which a scheme was laid out for the extension of the primary triangulation to the Gulf Coast, and incidentally thereto, for the measurement of the remaining portion of the oblique arc of the meridian, extending from the northeastern boundary to the Gulf of Mexico.

Since this reconnaissance was not completed until August 14, 1893, it is adverted to here as an important work, not to be passed over in the record of operations during the fiscal year 1894.

Establishment of an astronomical station at the Chicago University for the determination of local sidereal time in connection with observations for the force of gravity.—Commandant Defforges of the "Service Geographique" of the French army, having taken advantage of a voyage of duty to the United States to make relative observations of the force of gravity at seven stations on the continent of North America, arrived at Chicago in the autumn of 1893, and was met there by Assistant E. D. Preston, who had been instructed to make a series of time determinations in connection with the gravity work and to render such other assistance to Commandant Defforges as might be found necessary or desirable.

For this purpose Mr. Preston obtained permission to establish an astronomical station at the University of Chicago. The results obtained by Commandant Defforges at this station and at the others which he occupied, San Francisco, Mount Hamilton, Salt Lake City, Denver, Montreal, and Washington will enable him to bring out the continental anomaly of gravity.

Geodetic operations.—Occupation of stations in northeastern Tennessee and southwestern Kentucky, and along the Kentucky, Virginia, and Tennessee State lines.—At the beginning of the fiscal year Prof. A. H. Buchanan, Acting Assistant, was in camp at Station White Rock, in southwestern Kentucky, engaged in observations of horizontal and vertical angles for the extension of the triangulation to the northward and eastward, and its ultimate connection with the primary triangulation between the Maryland and Georgia base lines. This work was undertaken in accordance with instructions from the Superintendent, supplemented by detailed instructions from Assistant George A. Fairfield, in immediate charge of State surveys.

Field operations were continued in 1893 until November 15, then suspended for the season, and resumed June 15, 1894. At the close of the fiscal year they were still in progress.

Up to that date Professor Buchanan had occupied and completed observations at four primary stations, White Rock, Big Knob, Big Butt, and English, and at seven secondary stations along the Kentucky, Virginia, and Tennessee State lines, viz: Pinnacle, Kentucky Corner, Virginia Corner, Minter, Powell, Wildcat, and Cloud. Also at two secondary stations, Buzzard and Chimney, observed upon in connection with the primary work.

All of these stations were permanently marked and their markings described in the records. The stations at Kentucky and Virginia corners are exactly on the points that are recognized as such by the citizens, and the line stations are all located exactly on the marked State line.

On July 27, before obtaining all of the observations that he had intended to make at White Rock station, Professor Buchanan was obliged to break camp and move down the mountain in order to avoid an attack threatened more than once by a band of outlaws from Harlem County, Kentucky. Most of these men lived in the neighborhood of an illicit distillery about 2 miles from the station, and it was well understood that an attack made by them in strong force would have resulted in the plunder and destruction of the camp, and possibly in loss of life.

This check to the progress of the work was but temporary, however. Delays later in the season were due to unfavorable weather.

The last station occupied during the season of 1893 was Big Butt, in Tennessee Observations here were finished November 11, and the party moved down the mountains on the 14th, in a snow storm. On reaching home Professor Buchanan took up the preparation of his records and results for the archives.

From the 1st to the 16th of February, 1894, he was in attendance upon the Geodetic Conference held by direction of the Superintendent at the Coast and Geodetic Survey Office.

At the opening of the season in 1894 he began to make preparations for resuming field work as soon as funds were available. He began the occupation of station English about the middle of June in order to obtain some additional measurements of angles needed at that point, and on the last of the month was observing at Chimney Top Mountain, a secondary station.

ABSTRACTS OF REPORTS FROM FIELD PARTIES, FISCAL YEAR 1894.

MIDDLE DIVISION.

STATES AND TERRITORIES BETWEEN THE MISSISSIPPI RIVER AND THE ROCKY MOUNTAINS.

28. Minnesota.
29. North Dakota.
30. South Dakota.
31. Iowa.
32. Nebraska.
33. Missouri.
34. Kansas.
35. Arkansas.
36. Indian Territory.
37. Oklahoma Territory.
38. Louisiana.
39. Texas.

Progress Sketches Nos. 10, 11, 12, 18, and 19 show the localities of field operations in the Middle Division. A list of Progress Sketches will be found at the close of this volume.

Geodetic operations.—Continuation of the triangulation of the State of Minnesota.—At the beginning of the fiscal year, Prof. W. R. Hoag, Acting Assistant, was occupying Ellsworth, one of the stations in the scheme of triangulation along the Mississippi River between St. Paul, Minnesota, and Lacrosse, Wisconsin.

Observations were made for horizontal angles, for differences of elevation by micrometer, and for magnetic declination with a compass declinometer.

Station Maiden Rock, which, as well as Ellsworth, is on the Wisconsin side of the river was next occupied. A reconnaissance for determining the intervisibility of Vasa and Maiden Rock was completed and the stations Alma and Watopa were finally located.

On July 24, Professor Hoag was obliged to go to Chicago to serve as a member of the Jury of Awards at the World's Columbian Exposition, and he committed the immediate charge of the triangulation to Mr. Noah Johnson.

During his absence, the full complement of observations was secured at stations Maxville and Alma on the Wisconsin side of the river, and at Watopa on the Minnesota side. On August 18, Professor Hoag returned to his party, then at Wabasha City, on the Minnesota side of the river. He made a final selection for the site of Mount Vernon Station, Minnesota, and took up the construction of a tripod and scaffold signal at that point.

During the latter part of August, Assistant George A. Fairfield, who is in immediate charge of the State surveys, joined the party, and with Professor Hoag occupied Lake City, in Minnesota. The first ten days in September were devoted to observations for index error of the compass declinometer, and to an inspection with Mr. Fairfield of the triangulation in the vicinity of Minneapolis and St. Paul. This completed the work of the season.

In February, 1894, by invitation from the Superintendent, Professor Hoag was in attendance upon the meetings of the Geodetic Conference at Washington.

During the season of 1893, eighteen stations were occupied for observations of magnetic declination, and five stations for horizontal and vertical measures.

Geodetic operations.—Triangulation and topography in the vicinity of Minneapolis and St. Paul, Minnesota.—Instructions issued early in June, 1894, to Assistant W. C. Hodgkins, directed him to proceed to Minneapolis, Minnesota, and determine such additional points in the vicinity of that city and of St. Paul as would enable Professor Hoag, State Topographer, to begin a topographical survey of the State of Minnesota.

Mr. Hodgkins arrived at Minneapolis on June 16, and after a conference with Professor Hoag, and a general inspection of the region between and near the two cities it was decided to cover the region with a graphic triangulation, to be executed with a plane table, and to be based upon the trigonometric work already completed. It was thought best, however, to determine trigonometrically a few additional points; these were the stone tower at Fairview Park, in the northern part of Minneapolis; Pilot Knob, a station southeast of the village of Mendota, and the cupola of the headquarters building at Fort Snelling.

A plane-table sheet, scale 1–20 000, was then projected to include the district containing the two cities, and the graphic triangulation having been taken up it was continued to the end of the month, giving the positions of a large number of objects. Vertical angles were also observed at many of the stations for determining the elevations of the points.

Prof. W. R. Hoag served during the month as Acting Assistant and rendered efficient aid in the various operations. Hands and transportation were furnished by the State Topographical Survey.

Statements of progress after June 30, 1894, will appear in the next annual report.

Continuation of the transcontinental triangulation in Kansas along or near the thirty-ninth parallel.—At the beginning of the fiscal year, Assistant F. D. Granger, charged with the continuation of the transcontinental triangulation in Kansas, was occupying Station Schmidt, in Ness County, 9 miles northwest of the town of Ransom, on the Missouri Pacific Railroad. At this point the instruments were mounted on an observing tripod and scaffold signal 56 feet in height, and five primary, two secondary, and seven tertiary objects were observed.

The stations Big Creek and Schmidt, the former having been occupied in June, 1893, formed with Indian Creek and Canyon (stations occupied by Assistant Perkins in 1891), the connecting quadrilateral between the triangulation of central and western Kansas.

Upon the completion of observations at Schmidt, July 9, the party and instruments were transferred to Station Skaggs, a few miles northwest of Brownell, a town on the Missouri Pacific Railroad. Observations at this point were begun July 14 and finished on the 25th on five primary and five tertiary points, from an elevation of the theodolite of 50 feet. The party was then moved to Smoky Hill, an interior station in the figure, Hays, La Crosse, Trego, Skaggs. The theodolite here had an elevation of but 5·3 feet above ground. Five primary and four tertiary objects were observed, and the work was closed August 8.

Station Trego, in Trego County, about 9 miles southwest of Ellis, Ellis County, was next occupied. The observations at this station were made wholly by Mr. H. L. Stidham, Temporary Aid. The instruments were mounted on an observing tripod signal, 40 feet in height, and five primary and six tertiary objects were observed.

Upon the completion of the work at this point, August 25, the party was transferred to Station Southeast Base, about 5 miles southeast of the town of Russell in the county of the same name. This station being the southeast terminal of a projected base line and having never been occupied, it was deemed desirable to make it an astronomical station. Preparations were therefore made for determining time and latitude whilst the observations of horizontal directions were in progress; observations for azimuth were to be taken up later.

A temporary observatory of the usual form was built due east from the geodetic station, the center of the latitude pier being 6·16 metres distant from it. The instruments employed were meridian telescope No. 1 and a sidereal chronometer. For latitude sixteen pairs of stars, selected from the Coast and Geodetic Survey Catalogue (App. 7–1876), were observed between September 21 and September 30. Observations of horizontal directions were made on five primary and fifteen tertiary objects with the theodolite at an elevation of 19·2 feet.

In the observations for azimuth the theodolite was mounted on a heavy wooden tripod, carefully centered over the geodetic station, the telescope of the instrument being 5·7 feet above that point. A heavy stone pier was sunk 5 feet into the ground, and upon this the artificial horizon was mounted, the mercury being protected from the wind by a box having sight tubes properly inclined and the apertures covered by mosquito netting.

Observations for azimuth were begun October 2, Polaris being observed alternately direct and reflected in mercury while near eastern elongation, and the observations being referred to the azimuth mark. This was a light from a bull's-eye lantern showing through an aperture of 22 millimetres at Station Northwest Base, distant 3·3 miles.

The order of observation was as follows: One pointing on the mark, telescope direct with corresponding circle reading, followed by two pointings on star with noting of circle reading and time; the first pointing being on the star direct and the second on its reflected image. Telescope was then reversed, and the star again observed direct and reflected, and the set was finished with a pointing on the mark. The circle was used in seventeen positions, and the observations were completed October 8.

A comparison of the astronomical and geodetic latitude as derived from the field computations shows an apparent station deflection in the plane of the meridian of A.−G.=−4·03 seconds of arc, which seems to accord well with previous results obtained in Kansas. When, however, the astronomical is compared with the geodetic azimuth a large apparent station deflection in the plane of the prime vertical is discovered. A.−G.=−8·05 seconds of arc. Mr. Granger suggests that as this deflection may result from local causes, it would be well to observe for azimuth at one of the higher stations, Waldo or Blue Hill, of the base figure.

Field operations were closed after the work at Southeast Base was finished, and Mr. Granger having disbanded his party, proceeded to Washington and thence to New York, where he took up the computations of his season's work. He reports that his aid, Mr. Stidham, proved himself to be a very efficient and valuable assistant. In addition to making all of the observations at Station Trego, and most of the double zenith distances and micrometric observations during the season he made all of the observations for time and latitude at Southeast Base. Mr. W. N. Wadsworth rendered acceptable services as recorder.

For the season, July 1 to October 8, the statistics are:

Triangulation:	
Area of, in square statute miles	580
Number of stations occupied for horizontal measures	5
Number of stations occupied for vertical measures	5
Number of geographical positions determined	16
Number of elevations determined trigonometrically	10
Latitude, longitude, and azimuth work:	
Number of pairs of stars observed for latitude	16
Average number of observations on a pair	6
Number of nights of observations for azimuth	7

At each of the five stations of the triangulation the magnetic declination was observed with a compass declinometer.

Continuation of lines of geodetic leveling in Missouri and Arkansas.—Progress in leveling of precision from Olathe, Kansas, toward Fort Smith and Van Buren, Arkansas, by the party in charge of Assistant Isaac Winston up to June 30, 1893, was stated in the last annual report.

The simultaneous double line of leveling was continued from the vicinity of Belton, Cass County, Missouri, along the Kansas City, Clinton and Springfield branch of the Kansas City, Fort Scott and Memphis Railway to Harrisonville, Cass County, Missouri, this point being reached July 21. The line was then carried northward along the Lexington and Southern Division of the Missouri Pacific Railway to a junction with the transcontinental line of levels, forming a loop with a length of about 100 miles.

Work was then resumed at Harrisonville and extended south along the Lexington and Southern Division of the Missouri Pacific to the vicinity of Lamar, Missouri. Progress in this locality was delayed to such an extent by wind storms that the work was temporarily suspended under authority from the Superintendent and the party was transferred to Van Buren, Crawford County, Arkansas, at the southern end of the line. From this point the lines of leveling were extended north along the St. Louis and San Francisco Railway to Chester, Arkansas, where field operations were closed for the season on November 5.

The greater part of the railroads traversed was ballasted with gravel, and the atmospheric disturbances from heat were at times very large. Bench marks were established in all of the towns and villages along the route, and placed upon many of the stone abutments to bridges. The country in Missouri is in general a high open table-land, and the strong winds frequently caused trouble and delay. Occasionally the level bubble was held out of position by the wind four or five divisions for several minutes at a time, and during the latter part of September and first part of October about two weeks' work was lost on this account.

Mr. Winston observes that it will probably be necessary to devise an observing tent which can be quickly erected and dismounted in a frame on wheels, and which can be pushed along the railroad tracks when no train is near. This would serve admirably to protect the instrument against both sun and wind.

The use of velocipede cars for the transportation of the party was continued as far as Harrisonville and greatly facilitated the progress of the work.

Mr. W. G. Mitchell served acceptably in the party as rodman until the end of July, when he was obliged to return home on account of illness. Early in October Mr. A. B. Turner, whose services as recorder were valuable on account of experience gained in a previous season in Florida, was also obliged by sickness to leave the party.

The statistics of the work from July 1 to the close of the season are as follows:

Geodetic leveling:	
Number of kilometres leveled	235
Number of bench marks established	37

Reference to service assigned to Mr. Winston in Florida in the spring of 1894 has been made under a preceding heading.

Examination of the locality of a shoal reported off the South Pass, Mississippi River.—A shoal having been reported about 13 miles ESE. of South Pass Light, Mississippi River entrance, by the captain of the steamer *Albert Dumois*, instructions were given to Lieut. Geo. W. Mentz, U. S. N., Assistant Coast and Geodetic Survey, commanding the steamer *Blake* to proceed without delay to that locality, and make a careful hydrographic examination.

Leaving Pensacola April 17, Lieutenant Mentz arrived off South Pass with the *Blake* next day and between that date and April 29 kept the hand lead going continually each day with from 20 to 30 fathoms of line out, and used also the Bassnet sounding rod, a deep-sea line and the Sigsbee deep-sea sounding apparatus. He reports that he is satisfied that no shoal exists anywhere near the locality reported.

After completing the examination, Lieutenant Mentz returned to Pensacola and resumed his hydrographic work in that bay. Full records of the South Pass survey with soundings plotted on the charts have been forwarded to the Office.

Reconnaisance for a scheme of triangulation along the Rio Grande from El Paso, Texas, to the Gulf of Mexico.—In conformity with instructions dated February 28, 1894, Assistant Stehman

Forney resumed the reconnaissance along the Rio Grande. The territory covered by the scheme of triangles developed by him embraces about 500 miles of river line and covers 11 700 square statute miles of country, with triangle sides varying from 10 to 40 miles in length. Sixty-one stations were selected, and a base line 5 miles in length was laid out about 7 miles east of Brownsville, Texas. After leaving Eagle Pass, Texas, the country on the Texas side of the river is composed of rolling hills of about the same height, and covered with dense brush and cactus to the river bank. On the Mexican side the hills are higher and more prominent; this character of the country continues along the river as far as Fort Ringgold on the Texas side, and Camargo on the Mexican side. From there to the Gulf of Mexico, a distance of 140 miles, the country is flat, sloping towards the Gulf at the rate of about 10 feet to the mile, and thickly covered with mesquite brush and cactus.

At twenty-seven stations out of the sixty-one selected, observing scaffolds, ranging from 25 to 75 feet in height, will have to be built. All the points chosen were marked with piles of stones, whenever stones could be found, and by triangles cut in trees where stones could not be obtained. Owing to the smoky state of the atmosphere at all times of the year heliotropes will have to be used at most of the stations. From March 21 to August 1 the entire country from Eagle Pass to Brownsville, Texas, was suffering from the prolonged drought, which had lasted over four years, but copious rains fell after the last-mentioned date, and the vegetation quickly revived. Having completed the work assigned to him, Assistant Forney disbanded his party on September 30.

Mr. Forney states that the Mexican authorities, both civil and military, extended to him many courtesies and all the assistance in their power.

Magnetic observations continued at the self-registering station near San Antonio, Texas.—The instrumental equipment and personnel have remained the same as described in the last annual report. Mr. L. G. Schultz has had charge of the station, the instruments, and the observations. He tabulated and duplicated the records and partially computed them, and afterwards turned them over to Assistant R. E. Halter for further reduction and transmission to the Office.

The instrumental equipment consisted of a complete set of Adie magnetographs, a magnetometer, dip circle, theodolite, sextant, chronometer, galvanometer, a Wheatstone resistance set, and an ordinary resistance box.

Magnetographs.—Relative determinations.—Complete photographic records of the changes in the magnetic elements were obtained from the magnetographs. Observations for the determination of the values of the scale coefficients of the horizontal and vertical force magnets were made twice during the year for each instrument.

The following is the statistical table relating to the work:

Number of photographic sheets developed	327
Number of scale readings observed	2 210
Number of trace readings—declination	8 760
Number of trace readings—horizontal force	8 760
Number of trace readings—vertical force	8 760
Number of trace readings—thermograph	8 760
Number of temperature observations	2 190

Absolute determinations.—For determining the values of the several magnetic elements in terms of absolute units of force, observations were made on five days during each month of the year.

For rating the chronometer, observations upon the sun at equal altitudes were made once a month. The statistics relating to absolute determinations are shown in the table below ·

	Observations.	Determinations.
Declination	1 000	60
Oscillation	960	60
Deflections	1 200	120
Temperatures	420	—
Dip	5 760	120
Time	288	12

Earth magnetic currents.—The plant for observing earth currents was completed early in September. It consisted of 4 miles of copper wire divided into sections of 1 mile each, extending north, east, south, and west from the electrical laboratory containing the measuring instruments.

The observations showed currents of abnormally great and varying strength, and of constantly changing direction, but it was noted that the maximum strength of the currents observed was very constant, and also that the variations were uniformly within certain limits of the scale, and this led Mr. Schultz to conclude that the manifestations were due to electric street cars in the city, 3 miles distant. Experiments confirmed this view and showed that while the magnetic observatory is still within the region influenced by the cars, the magnets will not be materially affected as long as there is no metallic connection with the city through iron pipes or heavy wire. On the other hand further experiments made by Mr. Schultz with instruments procured with private funds, showed that the limit of influence of the electric cars is about 20 miles from the city.

Through the kindness of the San Antonio Electric Light and Power Company, a test was made of transmitting electric signals, using the earth alone as a conductor. A dynamo was kept running after the street cars had stopped, and an operator made and broke contact between the trolley wire in circuit with the dynamo and a rail of the car track. The sluggish galvanometer, 3 miles away, showed what was going on, and if sufficient time had been allowed between the makes and breaks of the circuit it would have been possible to transmit a message, or if by suitable arrangements induced currents had been used a message could have been read as easily as with a telegraph sounder.

Mr. Schultz acknowledges the generosity of Messrs. Fulton, who placed a telephone line 30 miles long at his disposal, and stationed a man at the far end to attend the switch board. This line, being 100 miles away from any electric power or light plant, gave the only really valuable results showing the correlation between the earth's magnetic phenomena and normal earth currents. After a few days of favorable weather observations were abandoned on account of thunder storms.

ABSTRACTS OF REPORTS FROM FIELD PARTIES, FISCAL YEAR 1894.

WESTERN DIVISION.

STATES AND TERRITORIES BETWEEN THE ROCKY MOUNTAINS AND THE PACIFIC.

40. California.
41. Oregon.
42. Washington.
43. Idaho.
44. Montana.
45. Wyoming.
46. Nevada.
47. Territory of Utah.
48. Colorado.
49. Territory of Arizona.
50. Territory of New Mexico.

Progress Sketches Nos. 2, 5, 6, 12, 13, 14, and 15 show the localities of field work in the Western Division. A list of Progress Sketches is given at the close of this volume.

Hydrographic examinations at San Pedro and San Diego, California.—As the presence of the *McArthur* was desired by the Navy Department on the southern coast of California in connection with the speed trials of the *Olympia*, her commander, Lieut. F. H. Crosby, U. S. N., Assistant United States Coast and Geodetic Survey, was directed to proceed to San Pedro for the purpose of a hydrographic inspection. Having located the wharves at Port Los Angeles and at Redondo Beach, and performed the special duties at San Pedro, the *McArthur* took part in the speed trial of the *Olympia*, and afterwards, in pursuance of instructions, Lieutenant Crosby sailed for San Diego to make an examination of the present condition of the old dredged channel through the middle ground of the entrance and to verify the charted depth on the bar. He was also instructed to search for a reported rock southwest from Point Loma, and to determine accurately the position of New Hope Rock. None was found to exist in the reported locality of the former, but the latter was readily located through the cooperation of Pilot A. F. Dill, of San Diego.

Leaving San Diego on the 7th of January, the *McArthur* reached San Francisco on the 10th. While awaiting favorable conditions for beginning work on the coast of Washington the *McArthur* began the development of the inshore hydrography of San Francisco entrance from Port Cavallo to the westward around Point Bonita.

Hydrography on the coast of Washington.—In the beginning of April the *McArthur* sailed for Ocosta, Washington, under instructions to develop the hydrography along the coast from James Island to Arch Rock, a duty on which Lieutenant Crosby was engaged at the end of the fiscal year. By that time the party had run 886 miles of soundings. More detailed statistics will be given in the next annual report.

Determination of the position of the wreck of the steamer "Los Angeles" off the coast of California, southwest of Point Sur.—Circumstances attending the wreck of the steamer *Los Angeles* off the south coast of California April 22, 1894, made it desirable that a careful determination of the position of the wreck should be made at the earliest date practicable. The lights of the steamer were seen from the Point Sur Light-house when she entered the rocky area between the mouth of Sur River and the light station, and the danger she was in was fully realized by those who saw her. She had been carried through the kelp field and upon dangers of which there were a dozen within 1½ miles, and was wrecked within about three-eighths of a mile of the coast and but little more than a mile in a southwesterly direction from Point Sur.

In accordance with telegraphic authority from the Superintendent and in compliance with instructions from Assistant Davidson, Assistant A. F. Rodgers proceeded without delay to occupy stations on the coast from which a good determination of the position of the wreck could be made. Driving down Sur Hill early on the morning of April 25, he first came in sight of the wreck, the main and fore masts of the vessel projecting about 20 feet above the surface of the water in a direction headed toward the light-house, her hull submerged and lying at an angle of about 30 degrees from the vertical.

Fortunately Mr. Rodgers found the Sur River signal in place as he had left it while executing the triangulation along the coast, and he was thereby enabled to go at once to False Sur Station, 210 feet in elevation and immediately overlooking the wreck. Having reerected this signal he went to Dry Hill Station, 650 feet above sea level, observing on Sur River, False Sur and Point Sur stations, and afterwards successively on the main and fore mast trucks of the steamer which he had to catch at the maximum of their curves of oscillation as they rolled with the wreck on the ocean swell. He also observed directions to the principal breakers on the Point Sur kelp patch, conspicuous to the coasting mariner in daylight; and so shown on the charts of the Survey under the headings of Sur Rock and Sur Breakers. Check determinations were made on the evening of this day and on the morning of the next by the occupation of False Sur Station and of Sur River Station. All of these observations were made with much difficulty owing to repeated showers of rain with gusts of strong southeast wind.

On the afternoon of the 26th, Mr. Rodgers went to the Point Sur Light-house in the hope of looking over the wreck from the light station, but the weather had become too thick and the wind too strong to permit observation.

Returning from the light-house at 4 p. m. it was noticed that the steamer's spars had disappeared and that the hull had broken in two parts and later one of these drifted ashore, showing that another day's delay would have made it impossible to determine the position. This having been determined on one day and verified on the next, showed that the vessel had not moved a certain 1 000 feet as had been claimed.

Mr. Rodgers has submitted with his report a tracing of the coast line and hydrography, on which is shown the position of the wreck and also the intersections of directions observed to the principal rocks, breakers, etc.

Determination of the position of the wreck of the "City of New York" on Point Bonita.—On October 26 the *City of New York*, a large steamer running to Japan and China, struck on the rocks under Point Bonita, San Francisco Bay, California, in a dense fog. Assistant A. F. Rodgers, in accordance with verbal instructions from Assistant Geo. Davidson, determined her position and with Mr. Westdahl made a series of soundings around the vessel. Assistant Rodgers acknowledges in his report the efficient service rendered to him by a life-saving crew and boat which had been detailed for duty with the stranded steamer. Mr. Edmonds secured interesting photographs showing the steamer's position in relation to the surrounding rocks.

Resurvey of shores of San Francisco Bay.—Under instructions of May 22, 1894, Assistant Aug. F. Rodgers began the field work for the resurvey of the shores of San Francisco Bay on June 7. Owing to the difficulty of recovering triangulation stations on which to base the topography, he began the determination of new points and on this work he was engaged at the close of the month, having by that time erected nine signals and occupied five stations.

Magnetic observations at San Francisco, California, and Seattle and Tacoma, Washington.—The regular series of observations of the magnetic elements which Assistant Davidson has maintained since 1852, and which are now particularly important because the maximum eastern variation is close at hand, was continued by observations at the Presidio Station on three days in November and December, 1893. The observations and computations were made by Sub-Assistant Fremont Morse, who was then attached to Assistant Davidson's party.

While occupying the longitude station at Seattle, Mr. Davidson established a magnetic station near the observatory and observed for declination and horizontal force. At Tacoma he established the magnetic station in the meridian of the longitude station and south of it. Observations were made on three days for declination and horizontal force.

Meridian line.—While occupying the astronomical station at Tacoma, Assistant Davidson established, by request of the park commissioners, a meridian line for the use of the city surveyor and of the United States deputy surveyors. The line passes through the astronomical pier and through a copper bolt secured in a drilled hole in the surface end of a large granite block 925 feet south of the observatory. He also furnished data to enable the park commissioners to engrave the latitude and longitude of the station on a copper plate at the observatory.

Tidal observations, Sausalito.—The automatic tide-gauge station at Sausalito has remained in charge of Assistant Davidson, but during the latter's absence on other duty was under the direction of Assistant A. F. Rodgers.

During the year the difference of level between the tide staff and the two bench marks was determined, once by Assistant Rodgers and once by Mr. F. W. Edmonds. Under the direction of the former Mr. Edmonds made, in January, a careful survey, plan, and elevation of the Sausalito tidal pier and house for a study for changes and repairs. Mr. Emmet Gray is the tidal observer and makes the tabulations, which are examined by Assistant Davidson and then transmitted to the Superintendent.

From January 1, Mr. Ferdinand Westdahl has compared each time and height of the prediction tide tables with the observed times and heights. In November, 1893, a submarine disturbance was recorded, which was also shown by the Honolulu tide gauge. Another one, which occurred in March, was recorded on the tide gauges at Aikawa and Kushimoto, Japan, as well as at Honolulu and Sausalito.

Pacific Coast Pilot.—Aids to Navigation, etc.—Assistant Davidson has continued the collection of material for the Pacific Coast Pilot, and has a large mass on hand, much of which has been prepared for publication. Reference to Assistant A. F. Rodgers's determination of the position of the wrecked *City of New York*, and of the steamer *Los Angeles* will be found in another place.

Assistant Davidson in transmitting the report in regard to the *Los Angeles* recommended that the dangerous locality be covered by a red ray from the light-house on Point Sur.

At the request of the Chamber of Commerce of San Francisco Assistant Davidson furnished that body with the descriptions of the hidden and visible dangers in the Bay of San Francisco and in the approaches.

During the season a small amount of hydrographic work was done between Mile Rocks and Point Lobos in the Golden Gate by Mr. Ferdinand Westdahl.

Telegraphic longitude between San Francisco, California, and Eugene, Oregon.—At the request of Professor Thompson of the United States Geological Survey, Assistant Davidson was authorized to occupy the Lafayette Park Station and exchange signals with Mr. S. S. Gannett, of the Geological Survey, at Eugene, Oregon. Arbitrary signals were exchanged on six nights in June. Observations for personal equation were made before the exchange of signals had been begun and after it was finished. The computations were begun by Mr. Davidson and finished by Mr. C. H. Sinclair. Mr. Gannett was furnished with a copy of all of the work.

Difference of longitude between Seattle and Tacoma.—In May Assistants George Davidson and C. H. Sinclair were ordered to Puget Sound to determine telegraphically the difference of longitude between Seattle and Tacoma. The station in Seattle had been connected with San Francisco and Portland by telegraph, and the station in Tacoma was the base station for the chronometric longitudes which had been carried to Sitka, and thence to the boundary stations in Alaska.

Assistant Davidson occupied the station at Seattle, in the State University grounds, after rebuilding the observatory and repairing the pier. Through the good will of the Western Union Telegraph Company, Mr. Brown, the manager at Seattle, led a main line to the observatory.

Assistant Sinclair reached Tacoma on May 13, and found the observatory and stone pier built by Assistant J. F. Pratt in 1892, in the northeast end of Wright's Park, in good condition. Rain and cloudy weather prevented observations until May 21; after that date time was observed on five nights and arbitrary signals were exchanged with the observer at Seattle.

Messrs. Davidson and Sinclair exchanged places on May 27, and the determination was completed by time signals on five nights, ending June 13. While at Tacoma, Assistant Sinclair determined the latitude of the station there by observations on twelve pairs of stars on five nights.

The work having been completed both observers proceeded to San Francisco.

Continuation of the triangulation of the Strait of Juan de Fuca.—Towards the end of May, 1893, as stated in the last annual report, Assistant J. J. Gilbert took the field under instructions to resume the triangulation of the Strait of Juan de Fuca, and by June 30, he had selected fifteen secondary points, built the signals needed, and had completed observations at Station Beechy Head, this station having been reoccupied to measure one direction—to Station Slip—which he was unable to observe during the preceding season.

Early in July, after posting heliotropers at three new points, a pier was built and observations begun at Station Striped Peak, on the American side of the strait. Instruments, camp equipage, and water had to be packed up a long steep trail to the summit of this peak, which has an elevation of about 6 000 feet (1 829 metres) above sea level. Bad weather delayed the work to some degree, but Mr. Gilbert was able to complete his observations at this station on July 12.

The next points occupied were Sherringham Point on the Canadian side and Slip on the American side of the strait. Work at both of these stations was finished by July 29, and on August 1 Mr. Gilbert landed at Station Arch Rock on the Canadian side, built a concrete pier for his theodolite and began observations next day.

These were finished, after some delay from fog and clouds, on August 9, and before occupying the next station, he posted a heliotroper at Tatoosh Island, cleared a vista at Station Classet, and selected a site for a station and built a pier at Bonilla Point near the entrance to the strait, and on the Canadian side. Station Vancouver on the same side of the strait was then occupied, observations having been begun August 14 and closed August 19.

Stations Waadah, Classet, and Tatoosh, all on the American side of the strait and near its entrance were next occupied in succession between August 21 and September 23. The occupation of Bonilla Point was begun September 25, and here the weather was very unfavorable, as it had been during several periods of the working season. Station Waadah was beneath the horizon and could be seen but a few times. Observations on all of the other stations having been completed October 5, and the steamer *Gedney* having arrived that day, Mr. Gilbert decided not to prolong his stay at Bonilla Point with the chance of being weather-bound. A comparatively safe landing was found about a mile east of the station, and from that landing everything was safely transferred to the steamer, notwithstanding the extremely heavy sea that was running.

On October 10, Mr. Gilbert left the *Gedney* at Port Townsend and returned to Olympia, thus closing field work for the season. In his report he expresses his appreciation of the uniform courtesy of Lieut. Lucian Flynne, U. S. N., Assistant Coast and Geodetic Survey, commanding the *Gedney*, and of all the officers associated with him, and testifies to their hearty cooperation in all efforts to forward and expedite the work.

Mr. Gilbert has accompanied his report with a sketch of his triangulation and statistics of the season's work. These are as follows:

Triangulation:	
Area of, in square statute miles	865
Number of signal poles erected	19
Number of stations occupied for horizontal measures	10
Number of stations occupied for vertical measures	7
Number of geographical positions determined	46

Vertical angles were measured at most of the stations, but these measures were made subordinate to horizontal directions.

Magnetic observations were taken with the declination compass at each station, and were kept up at some stations for eight days, when the length of stay permitted.

During January and February Mr. Gilbert was in attendance on the Geodetic Conference in Washington, D. C., and on its adjournment he returned to Olympia and completed the office work of the previous season. On May 16th he joined the *Gedney*, and three days later field work was begun in Washington Sound by the erection of signals. Before the end of the fiscal year more than one hundred signals had been built, and forty stations had been occupied, thus connecting the triangulation of the Canal de Haro with the work of 1888.

Hydrographic surveys in the Strait of San Juan de Fuca.—Lieut. Lucian Flynne, U. S. N., Assistant United States Coast and Geodetic Survey, commanding the steamer *Gedney*, in his report for the fiscal year 1894, states that during the working season in the field, from July 1 to October 10, 1893, his party was primarily engaged in cooperating with Assistant Gilbert in the triangulation of the Strait of San Juan de Fuca. At such times during the period as a division of forces could be made without interfering with the progress of the triangulation, hydrography was executed in the strait between Pillar Point and Waadah Island, near Cape Flattery.

The results of this hydrographic survey and of the hydrographic examinations made in connection with it are shown on three hydrographic sheets, on scales of 1–10 000, 1–20 000, and 1–80 000, respectively. Accompanying these sheets Lieutenant Flynne has submitted a descriptive report. He observes that although the ship's lines of soundings extended across the strait to the Vancouver Island shore, special examination was directed to the Washington shore only.

The coast between the limits of the general survey is high and bold and thickly wooded, the only indentation of importance being Clallam Bay, of which a special examination was made. This bay affords fair anchorage and moderate protection for vessels in southeasterly and southwesterly gales. Westerly and northwesterly gales create a heavy swell in the strait, and this finds its way readily into the bay.

In entering from the eastward, Slip Point should be given a wide berth, as a rock awash at high water lies about 450 metres to the northward of that point. Lieutenant Flynne suggests that a bell buoy should be placed to mark this rock at night or in thick weather, and that it be named Slip Rock.

In entering the Strait of San Juan de Fuca sailing vessels generally keep to the northward of Duntze Rock, also many steamers. But the San Francisco steamers, and others from the south that are acquainted with the locality, are inclined to enter between Duncan Rock and Tatoosh Island, both of which are always visible in sunny weather, and the latter having a first-order light and steam fog signal. Vessels passing in keep nearer to Tatoosh Island than to Duncan Rock, as a shoal of small extent makes out to the southward and eastward of that rock.

The entrance to the strait is marked by Tatoosh Island Light and by Carmanch Light on Vancouver Island, British Columbia, the former being the more powerful as well as more important. Once clear of the entrance dangers, a course is readily laid by chart to the port of destination.

Full details in regard to hydrographic characteristics of the waters with the limits of his survey are given by Lieutenant Flynne in his descriptive report. A rock reported off Middle Point, and a shoal reported off Duncan Point, were both found by dragging with a submerged line, and the hydrography was delineated on tracings from the original sheets of survey. Buoys have since been placed by the Light-House Board outside of the rock off Middle Point, and also outside the foul ground discovered off Point Wilson.

The officers attached to the party during the season were Lieut. R. F. Lopez, U. S. N.; Ensign Benjamin Wright, U. S. N., and Pay Yeoman F. C. Schubert, U. S. N.

For the season, beginning May 19 and ending October 17, 1893, the following statistics are reported:

Hydrography:	
Area sounded in square geographical miles	266
Number of miles (geographical) run while sounding	228
Number of angles measured	1 369
Number of soundings	1 190
Number of specimens of bottom preserved	36

During the winter the *Gedney* was at Seattle for repairs and refitting for the next season, and on May 1, 1894, Lieutenant Flynne reorganized his party on board of her, and was later joined by Assistant Gilbert for combined operations in Washington Sound. His first work was in the eastern part of the Strait of San Juan de Fuca, from Ediz Hook to Whidbey Island, and its statistics to the close of the fiscal year are:

Hydrography:

Area sounded in square geographical miles	214
Number of miles (geographical) run while sounding	325
Number of angles measured	1 483
Number of soundings	600
Number of specimens of bottom preserved	15

Reconnaissance in Colorado.—In August, 1893, Assistant F. W. Perkins was instructed to take up the reconnaissance for completing the connecting scheme between the eastern and western branches of the transcontinental triangulation in Colorado. Mr. Perkins took the field on September 4, and closed field work on October 26. Of the two schemes of triangulation submitted by him, one shows a proposed connection of the mountain stations with the base measured by Assistant Tittmann in 1880, and slightly modifies the scheme suggested by the latter at that time. The other scheme contemplates a triangulation overlapping the work already completed from the base to the eastward, and does not connect with the base as directly as seems desirable, and would necessitate the use of high observing tripods and signal poles.

In regard to their use, Mr. Perkins states that he sees no reason why, with proper precautions, observing stands of any height found practicable elsewhere may not be used on the plains of Colorado, and made to withstand the fierce sweep of the winds across these plains. The width of the structure for an observing tripod and scaffold should be as small as the conditions will permit. A platform 8 or 9 feet square will be found ample for the purpose of the observer; a rail above the level of the eye being provided to secure the observing tent to. The scaffold should be closely boarded from ground to platform, and when it is being framed with this in view, the ties and braces should be halved where they cross each other and reduced to a common thickness (say 2 inches) where they rest upon the legs, the spaces between them being filled in with 2-inch furring pieces. So protected, the width of the tripod can be reduced to the requirements of simple rigidity, and the base of the scaffold to a size just sufficient to inclose the tripod, while resistance to the force of the wind should be provided for by wire guys.

Mr. Perkins advocates the use of lozenge-shaped pieces of calico, black and white, secured to tall poles, as a substitute for heliotropes, stating that if a sufficient area of both colors is used an average of more observing hours a day will be obtained on lines of 60 miles and over than from a heliotrope. When the length of line demands an increase of surface in the object observed upon, he found it advisable to add to the number of small lozenges rather than to the area of single ones.

Acting Aid Henri Boleslawski von der Trenck rendered efficient service during the season.

Continuation of the Transcontinental Triangulation in eastern Utah and western Colorado.—In the prosecution of this work, and at the beginning of the fiscal year, Assistant Wm. Eimbeck was engaged in transferring his party, instruments, and camp equipment to Mount Waas, the elevation of which is about 12 600 feet above the sea level. On the completion of work at that station, Treasury Mountain, 13 600 feet high, was occupied. Horizontal and vertical angles were measured, and observations for azimuth and latitude, and for the determination of the magnetic elements, were made at each of these stations. The boundary line between Utah and Colorado passes about ten miles to the eastward of Mount Waas, from which a subsidiary triangulation was extended so as to connect this primary station with three well-authenticated boundary stakes.

When the work at Mount Waas had been finished, one division of the party, under the direction of Sub-Assistant John Nelson, was dispatched to Treasury Mountain to prepare it for occupation, while Mr. Eimbeck, taking personal charge of the other, occupied Mesa, a secondary point in the net connecting the telegraph longitude station at Grand Junction. Early in September Assistant Eimbeck ascended Mount Ouray for the purpose of deciding on the best method of extending the triangulation to the eastward. The season's work was finally brought to a conclusion by the occupation of the telegraphic longitude station at Gunnison, Colorado, for the purpose of connecting it geodetically with Mount Ouray and Uncompahgre Peak; besides the horizontal angle measurements there, the astronomical latitude and azimuth were observed. Field work was closed for the season on October 15. Sub-Assistant John Nelson, and Messrs. R. L. Faris and Chas. C. Yates, temporary aids, assisted Mr. Eimbeck throughout the season, and receive his earnest commendation for their services.

During the winter Mr. Eimbeck was engaged at this Office in reducing his field observations, and in January and February he participated actively in the daily sittings of the Geodetic Conference.

In May, 1894, instructions were issued, looking to as early a resumption of field work as the state of the appropriation would allow. Assistants Wm. Eimbeck, F. W. Perkins, and P. A. Welker were directed to take the field in June, to be followed in July by a fourth party in charge of Assistant F. D. Granger, so as to complete, if possible, the junction between the eastern and western triangulation during the season. The chief of each of these parties was to submit his own estimates and accounts directly to the Office, but the general direction of the work was given to Assistant Eimbeck, so as to in insure concerted action between the parties.

Mr. Eimbeck made a preliminary reconnaissance in eastern Colorado to test the intervisibility of Ouray and a point to the eastward of the mountains. Having made the reconnaissance, he organized his party in Utah, and by the end of June had completed the trail up Mount Ouray, and was engaged in transporting the camp and instruments up the mountain.

To Assistant F. W. Perkins was assigned the reconnaissance and occupation of the northeastern portion of the great figure which was to have Pikes Peak for its central point, the continental divide for its western limit, and to include to the eastward points in the scheme crossing the plains of Colorado. Under instructions dated June 2, Mr. Perkins reached Denver on the 14th, and went from there, via Colorado Springs, to the summit of Pikes Peak to inspect the site of the old signal, and to make his plans for building another. From Pikes Peak he went, via Eastonville, where he engaged a heliotroper, to Station Divide, to test the visibility of certain points to the westward. As a result, he found that Mount Elbert is not visible from Divide, and therefore he selected Bison, the principal peak of the Taryall Mountains, as a point to be visited. Returning to Denver, he was joined by his recorder, Mr. Frederick Law Olmstead, jr., with whom he at once started for Bison, notwithstanding that the instrumental equipment had not yet arrived from Washington. Reaching Bison, he found that all the stations involved in the proposed scheme were visible from it, and therefore he at once ordered the preparation of a trail, while he returned to Pikes Peak to superintend the erection of a signal there. In this duty he was engaged at the end of the fiscal year.

Assistant P. A. Welker received instructions on June 4, to arrange for the occupation of Mount Elbert and Mount Uncompahgre, Colorado, selected stations in the transcontinental triangulation. These mountains are above fourteen thousand feet high and are the two highest and roughest stations in the scheme of triangulation across the continent; and although their occupation is an extremely difficult undertaking, Assistant Welker and his party were on the summit of Mount Elbert and ready to begin operations by the end of June.

ABSTRACTS FROM REPORTS OF FIELD PARTIES, FISCAL YEAR 1894.

51—DIVISION OF ALASKA.

Under this heading are included the coasts of Alaska which border on the North Pacific Ocean, on Bering Sea, and on the Arctic Ocean; also the inlets, sounds, bays, and rivers. (See Progress Sketch No. 3.)

Hydrographic and general surveys in Alaska.—From the beginning of the fiscal year until the end of August the steamer *Patterson* under the command of Lieut. Commander W. I. Moore, U. S. N., Assistant United States Coast and Geodetic Survey, was engaged in the survey of Sitka Harbor and its approaches.

A tide gauge was established at Hot Springs, and comparisons were made between it and the one at Japonski Island. The latter was observed throughout the season and compared with the self-registering gauge at the Government wharf at Sitka. During the progress of the survey all local information obtainable in regard to rocks, shoals, and extension of reefs was utilized and verified by observation and development. At all the lower low waters the positions of rocks and points of reefs were observed and determined. Owing to the great irregularities in soundings in the inshore hydrography it was found necessary to run the lines of soundings at very short intervals, while special developments were made whenever necessary. The offshore soundings terminate in 106 to 109 fathoms. Lieut. Commander Moore states however that Indians report the existence of a bank on which they anchored while sealing off the mouth of Sitka Sound.

During the progress of the work current observations were made on ten days, and observations for the heights of islands on six. Towards the latter part of the season a boat-house with launch ways was built for the *Cosmos* on Japonski Island.

Closing work for the season the *Patterson* sailed from Sitka on September 1, for Taku Inlet, where members of the boundary survey parties were taken aboard. Calling at Fort Wrangell and Burroughs Bay the *Patterson* sailed southward in company with the *Hassler*, after having taken aboard the boundary survey parties of Messrs. Ogden, Tittmann and McGrath, which had assembled at the former place, and at the latter Mr. Dickins's astronomical party.

Port Townsend was reached September 14, and San Francisco on the 18th of that month. Reference to the movements of the *Patterson* in connection with the speed trials of the *Olympia* will be found under the heading of Special Operations. The *Patterson* returned to San Francisco from Santa Barbara Channel and reached the navy-yard on December 20.

Early preparations were made to fit the vessel for the resumption of field work in Alaska in the spring of 1894. In pursuance of instructions relating to this work the *Patterson* sailed from San Francisco with Assistant Morse and Mr. Edmonds on board, and at Port Townsend was joined by Assistants McGrath and Dickins. Other members of the boundary survey parties had joined the *Hassler* and the two ships sailed for the working ground on the 28th of April.

After landing Mr. Dickins's party at Burrough Bay, Mr. Morse at Sitka, and Mr. McGrath at Cape Manby, Yakutat Bay, the *Patterson* returned to Sitka, arriving there May 23. Proceeding to Chatham Straits the regular survey was begun; an astronomical station and a tidal gauge were established in Pavlof Harbor, another tide gauge for comparison was built in Funter Bay, and all of the work was well under way by the end of the fiscal year.

The officers of the *Patterson* during the year were:

Lieut. Commander W. I. Moore, commanding; Lieut. A. P. Niblack, detached October 29, 1893; Lieut. Jas. H. Sears, joined March 31, 1894; Lieut. R. F. Lopez, joined January 15, 1894; Ensign (Lieut.) Hugh Rodman; Ensign J. G. Doyle, detached February 20, 1894; Ensign G. Tarbox; Ensign W. B. Hoggatt, joined February 1, 1894; Passed Assistant Surgeon C. J. Decker; Assistant Engineer H. G. Leopold.

Statistics of the work are given as follows:

Season of 1893:	
Number of angles measured	4 961
Number of soundings	7 181
Miles of soundings	747
Area covered, square miles	160
Season of 1894—May and June:	
Number of angles measured	1 815
Number of soundings	2 820
Miles of soundings	364
Area covered, square miles	160
Area square miles of triangulation	516
Stations occupied for horizontal angle measures	173
Latitude station occupied	1
Longitude station chronometric	1
Number of tide gauges established	2

Transportation of boundary survey parties, of chronometers between astronomical stations and hydrographic and topographic developments.—In July, 1893, the *Hassler* under the command of Lieut. Giles B. Harber, U. S. N., Assistant Coast and Geodetic Survey, was engaged in carrying chronometers between Sitka, the base astronomical station and Burroughs Bay, Fort Wrangell and Taku Inlet. While engaged in this work Lieutenant Harber searched for and determined the position of a reef, the existence of which had been reported by Captain Wallace of the Pacific Coast Company's steamer *City of Topeka*.

The reef, which is situated in Felice Straits between Duke and Annette Islands was readily found, heavy growing kelp clearly marking portions of it. The least depth of water was found to be 2 fathoms near the western end of the reef. Lieutenant Harber suggests that the reef be called "Wallace Reef."

Another reef, which uncovers, at low water, was discovered in Kasaan Bay, to the northward of Skowl Arm, and its position was determined.

During July and August four round trips were made between Sitka and the observatories above mentioned. On the first of these trips the *Hassler* transported Assistant McGrath's party from Taku Inlet to Wrangell and Assistant Ogden's on the second trip during the same month.

On September 4 the *Hassler* in company with the *Patterson* started for Puget Sound, stopping on the way at Port Simpson to haul the *Fuca* up the ways of the boathouse. Proceeding to Tacoma the *Hassler* was moored there for the winter. In March the ship was prepared for duty in Alaska. Sailing from Port Townsend on April 28, with some of the boundary survey parties on board, the *Hassler* reached Pyramid Harbor, Lynn Canal, on May 12, and on the 16th, sailed for Sitka, observations for time having been obtained at Pyramid Harbor.

During June the vessel made two round trips between Sitka and Pyramid Harbor, and also went to Loring to carry Assistant Dickins and party from there to Pyramid Harbor.

In accordance with instructions, whenever the weather permitted topographic sketches of salient features along the routes traversed by the *Hassler* were made, in order to supply data for perfecting the charts.

The following officers served on the *Hassler* during the fiscal year:

Lieut. Giles B. Harber, commanding; Lieut. C. F. Emmerich, detached December 4, 1893; Lieut. O. C. Almy, joined March 12, 1894; Ensign L. J. Clarke, detached March 1, 1894; Ensign C. P. Eaton, detached January 15, 1894; Ensign W. S. Clarke; Ensign H. R. Benham, joined March 3, 1894; Passed Assistant Surgeon C. H. Lowndes; Assistant Engineer W. C. Herbert.

SPECIAL OPERATIONS.

Action taken by the Commissioner on the part of the United States conjointly with the Commissioner of the Dominion of Canada to determine upon a method of marking more accurately the boundary line between the two countries in the waters of Passamaquoddy Bay.—Under the second article of a convention between the United States and Great Britain, concluded at Washington, July 22, 1892, it was agreed that the Government of the United States and of her Britannic Majesty in behalf of the Dominion of Canada, should with as little delay as possible, appoint two commissioners, one to be named by each Government, to determine upon a method of more accurately marking the boundary line between the two countries in the waters of Passamaquoddy Bay in front of and adjacent to Eastport in the State of Maine, and to place buoys or fix such other boundary marks as they may determine to be necessary.

On September 8, 1892, the Superintendent was appointed by the President as the commissioner on the part of the United States under that article of the convention and was soon afterwards informed that Mr. W. F. King, chief astronomer of the department of the interior of the Dominion of Canada had been appointed Canadian commissioner.

During July and August, 1893, the commissioners were in the field engaged in the survey of the region for the determination of suitable range lines and similar investigations. An examination of the existing conditions, especially as to currents and tides, convinced the commissioners that it would be impossible to maintain buoys at all of the turning points which might be agreed upon, and that nothing short of the establishment of shore ranges indicating the direction of the boundary line, and also the location of its turning points would be satisfactory.

Prominent natural objects such as the edge of a steep bluff, or a large rock were used as range marks when available, and also prominent artificial objects, such as church spires, tall chimneys, or the gable of a house. At some points monuments were erected, consisting of conical piles of boulders, no cementing material being used in their construction, but care being taken to arrange the successive layers so as to insure stability. The dimensions of these monuments depended on their location, and on the length of the line over which it was intended they should serve as range marks.

By a trigonometrical connection with the Coast and Geodetic Survey triangulation, all of the range marks were determined in geographical position; descriptions and topographical sketches were also made of them, defining the ranges which might be decided upon by the commissioners.

The party of the Superintendent consisted of Assistant D. B. Wainwright, C. E. Mendenhall, acting aid, and the men composing the crew of the steam launch.

Ten signals were erected, ten stations occupied, and twenty-seven geographical positions determined.

A joint report of the results reached will be made in due time by the commissioners to their respective Governments.

Astronomical observations for the variation of latitude.—Observations at Rockville, Maryland.—The observations which were being made at the close of the last fiscal year by Assistant

Edwin Smith were continued by him in July. During that month Mr. Smith obtained ninety-three observations on eleven pairs of stars on nine nights. The plan of resuming the observations in October and November was given up on account of the pressure of other official duties, which would have prevented Mr. Smith from making them continuous for so long a period as was deemed desirable.

Observations at San Francisco.—For the purpose of verifying the obscure minimum predicted by Dr. Chandler's formula, Assistant George Davidson voluntarily undertook, without expense to the Survey, and in addition to his other official duties, to observe for latitude during November and December. The stars used were the same as those observed by him at the corresponding season in 1891.

Observations for value of micrometer screw were made on eleven nights, and in these observations he was aided by Mr. F. W. Edmonds and Mr. T. D. Davidson. Zenith telescope No. 3, which had been reconstructed in 1892, was used.

After his return from Puget Sound in June, 1894, Assistant Davidson resumed the latitude observations at Lafayette Park Station, continuing them until July 26, 1894. Though the weather was adverse, observations were obtained on seventy-eight pairs and triplets of stars.

Physical hydrography.—Continuation of the survey of the oyster grounds of Virginia.—Assistant J. B. Baylor has continued the work undertaken at the request of the State of Virginia, of surveying the oyster grounds of that State.

He has filed in the archives of this office eighteen published oyster charts of Chesapeake Bay and its tributaries, prepared under his direction during the fiscal year ending June 30. The statistics for the fiscal year are embraced in the following summary:

Two hundred and fourteen triangulation stations were determined and marked.

One thousand five hundred and eighty-seven corners of oyster rocks were located and their positions fixed by logarithmic computations.

Eighty-one thousand and thirteen acres of oyster ground were surveyed.

Mobile Bay and vicinity.—Survey of oyster grounds for the United States Commission of Fish and Fisheries.—Early in February Mr. Homer P. Ritter was detailed by request of the United States Fish Commissioner, Col. Marshall McDonald, to make a survey of the oyster beds in Mobile Bay, under the direction of the Commissioner. The special object of this survey was to determine the positions, outlines, and characteristics of the oyster beds and of the areas of the bottom suitable for the planting of oysters.

Mr. Ritter began field operations on February 7, and these were continued until March 24, when the party was disbanded.

On the date of Mr. Ritter's report the field notes were being plotted by Mr. W. F. Hill, of the Fish Commission, under Mr. Ritter's direction, with a view to having the results in such shape that a report and map embodying the results of the survey can be furnished after Mr. Ritter's return from Alaska, whither he was ordered in connection with the international boundary survey of Alaska.

The statistics of Mr. Ritter's field work are given as follows:

Number of soundings	3 023
Number of angles measured	1 201
Number of densities and temperatures determined	158
Number of specimens collected	30
Area examined (roughly), square miles	300
Area examined (more minutely), square miles	50
Tide gauge established	1

Resurvey of the boundary line between the United States and Mexico.—Assistant A. T. Mosman continued his duties as a member of the International Boundary Commission between the United States and Mexico during the whole of the fiscal year ending June 30, 1894.

Mr. Mosman highly commends the services of Messrs. John F. Hayford and James Page, who, after their duties under the Commission had been completed, were assigned to the parties organized to continue the Alaska boundary survey.

Resurvey of that part of the boundary line between the States of California and Nevada which extends from a point in Lake Tahoe to the Colorado River.—The last annual report contains an account of the work done in connection with this survey up to September 30, 1893. As there stated, Assistant George Davidson had general direction of the work. He returned to San Francisco on September 9, but Assistants Sinclair and Fairfield continued the operations until October 27. Having stored their outfit at Carson, they proceeded to the suboffice in San Francisco, and duplicated the records and inked the topographical sheet.

The following statistics relate to work done in addition to the latitude and longitude work:

Number of signals erected for triangulation	28
Number of stations occupied	14
Number of angles measured	225
Number of angle observations (repetitions) made	2 801
Topography:	
Number of miles of shore line surveyed	4·5
Number of miles of railroad and other roads	1·1
Area surveyed on topographic sheet in square miles	4·2

Cooperation in the speed trial of the new U. S. cruiser Olympia.—At the request of the Navy Department, the *Patterson*, Lieut. Commander W. I. Moore, U. S. N., Assistant United States Coast and Geodetic Survey, was detailed, October 12, to report to Captain Scotten, U. S. N., the senior officer of the board appointed for the speed trial of the cruiser *Olympia*, for duty in connection with the board. On this duty the *Patterson* sailed from San Francisco on October 22, for Santa Barbara Channel.

The course, based on the coast triangulation, was the same as that established by this Office for the U. S. S. *San Francisco* in Santa Barbara Channel, but with an eastern extension of 3 miles, which was laid out by the *Patterson*. The steamer *McArthur*, Lieut. F. H. Crosby, U. S. N., commanding, was also detailed to take part in the trial which occurred on December 15, and was satisfactory.

Continuation of reconnaissance and general surveys in southeastern Alaska for the collection of data and the preparation of maps intended to aid the United States and Canadian Governments in the location of the boundary line between Alaska and British Columbia.—The provisions of the treaty of 1867 between the United States and Russia relating to the Alaska-British Columbia boundary line were quoted in the last annual report, and in view of those provisions, instructions were issued by the Superintendent at the outset of the season of 1893 to the several chiefs of the Alaska Boundary parties directing them to collect all possible geographical information, particularly as to the location of mountain peaks and the existence of a range of mountains parallel to the coast, and in the event of finding such a range, to determine its general trend and its distance from the coast, unless such distance should considerably exceed the ten marine leagues specified in the treaty.

Abstracts of progress to the close of the fiscal year 1893, as derived from the reports of the chiefs of the field parties were given in the last annual report.

The reports of field operations to the close of the season in that year are now available and are here summarized; also the reports of progress to June 30, 1894, submitted by the officers assigned to duty in that year on the Alaska Boundary Survey.

Surveys on the Unuk and Stikine rivers.—On July 1, 1893, the party in charge of Assistant E. F. Dickins had reached a point on the Unuk River about 24 miles above its mouth. Mr. Dickins had been assigned to duty in cooperation with one of the Canadian parties engaged in making a preliminary survey for the location of the Alaska-British Columbia boundary.

The current of the river in several of the reaches through which the party had to drag their loaded canoes was very swift and full of whirlpools. On July 1, a timber jam was encountered around which the first canoe, loaded with provisions, was guided safely, but the second one, loaded with camp outfit, clothes, blankets, etc., took a sudden sheer, capsized, and filled and swept down stream immediately. The outfit was partially recovered after two days' search, but not without great discomfort to the chief of the party, who lost a canvas bag containing all of his clothing except what he had on at the time of the accident.

By the 8th of July the reconnaissance had been carried to the mouth of the second canyon, 27 miles above the observatory on Burroughs Bay at the entrance to the river, and here the party was detained by high water, the canyon being so filled with a raging torrent that it was not safe to enter it.

On the next day Mr. St. Cyr, the Canadian surveyor, decided to abandon the river work for the season, and with several of his party to ascend the mountains to the wetsward to obtain photographic views of the surrounding country. Mr. Dickins accordingly started down the river and joined Mr. Edmonds, the astronomer of his party, whom he had left in charge of the astronomical station on Burroughs Bay.

Remaining there a week he reoccupied and checked his observations at the stations of the triangulation, and during this time Mr. Edmonds obtained his first night of observations for latitude. Continuous cloudy and rainy weather had prevented him from getting more than a number of broken time sets. He had, however, been able to complete his magnetic observations.

On July 22, the steamer *Hassler* arrived, and after chronometer comparisons had been obtained Mr. Dickins went aboard and was landed at Fort Wrangell next day. Here he found Assistant Ogden with his party, and after consultation with him it was agreed that as soon as suitable boats for transportation of party and outfit could be procured, they would proceed to the Stikine River and work from the mouth up, Mr. Ogden making the triangulation while Mr. Dickins did the topography. They would thus cooperate with Assistant Tittmann who had advanced the survey of the upper reaches of the river.

On August 1, Messrs. Dickins and Ogden took a canoe and three men and went up the Stikine to consult with Messrs. Tittmann and McGrath in regard to the work, and satisfactory arrangements having been made, they began the triangulation and topography on August 5, and by the 18th of the month had completed both from the mouth of the river to a junction with the work of Mr. McGrath near the Popoff Glacier.

Mr. Dickins having ascertained that there was no possible way of returning to his party at Burroughs Bay, accepted the offer of passage to Sitka on the steamer *Hassler* which had arrived August 20 en route for that port. After reaching Sitka, he took up his quarters aboard the steamer *Patterson*, and left that port in her September 1, homeward bound, taking Mr. Edmonds on board from his astronomical station at Burroughs Bay.

Mr. Dickins acknowledges the faithful and efficient service rendered by Mr. Edmonds as astronomer in his party. He completed all of the observations for time, latitude, and the magnetic elements without assistance. To the commanding and wardroom officers of the steamers *Patterson* and *Hassler* Mr. Dickins expresses his appreciation for kindly and courteous treatment, notwithstanding many inconveniences due to the crowded condition of the ships.

The statistics of the season of 1893 are as follows:

Alaska Boundary reconnaissance:

Number of triangulation stations occupied	9
Number of traverse stations occupied	79
Number of miles of traverse line run	27
Area of topography sketched in square statute miles (approx.)	200
Number of pairs of stars observed for latitude	42
Average number of observations on a pair	4·6
Number of stations occupied for azimuth	2
Number of magnetic stations (declination, dip, and intensity)	1

Alaska boundary work.—Chronometric exchanges of time comparisons for longitude between Sitka observatory and the astronomical stations on the Taku, Stikine, and Unuk rivers, in 1893.—Self-registering tidal station established at Sitka.—Assistant Fremont Morse has reported the completion of the work assigned to him in the spring of 1893, in connection with the chronometric determination of the longitudes of the astronomical stations of the Alaska Boundary parties on the Taku, Stikine, and Unuk rivers.

As during the preceding season, the chronometers to be carried back and forth were placed aboard the steamer *Hassler*, and in 1893 Mr. H. C. Lord was directed to report to Mr. Morse and to take charge of the chronometers aboard the *Hassler*, making the usual daily intercomparisons, and comparing the ship's chronometers with those of each station on arrival.

The first observations for time at the Sitka observatory were obtained by Mr. Morse on May 16, and from that date to the end of the field season on August 31, observations were made on every clear night. In all twenty-eight nights observations were obtained.

The *Hassler* started on her first chronometer trip on May 18, and made seven round trips during the season. Comparisons were made with all three astronomical stations at each trip, except that on the seventh trip, owing to head gales and a short coal supply, the steamer did not stop at Burroughs Bay (Unuk River Station).

On one of the trips, Mr. Lord exchanged places with Mr. Putnam, the observer at Fort Wrangell. Mr. Morse mentions with commendation the careful and conscientious manner in which Mr. Lord discharged his duties. He took special pains to fit up a temperature box in which to keep the chronometers, and so placed it as to avoid to a great extent the jarring of the engine when the steamer was under way.

On August 15, 16, and 17 Mr. Morse made a series of magnetic observations at the Parade Ground Station. The resulting declination was 29° 34′ E. of N., agreeing closely with that found the season before.

The Stierle self-registering tide-gauge record, referred to in the last annual report, was kept up at Sitka, beginning with June 27, 1893, until the close of the season. But few breaks occurred, and those were due to a defect in the construction of the instrument. When Mr. Morse left Sitka, he placed the gauge in charge of Mr. Edward de Groff, who has since been acting as tide observer.

He expresses his obligation to Mr. N. R. Peckinpaugh, clerk of the United States District Court at Sitka, for his kindness in placing at his disposal a room for office work.

Triangulation, topographic reconnaissance, and determination of latitude, longitude, and azimuth for the survey of the Stikine River.—At the beginning of the fiscal year the party of Assistant O. H. Tittmann had made good progress in the several classes of field work incident to the survey of the Stikine River, southeast Alaska. As stated in the last annual report, Mr. Tittmann had organized his party and gone into camp near the mouth of the Stikine on May 9, and had been joined at that date by Mr. H. H. Robertson, Dominion Land Surveyor, representing the Canadian Commissioner, Hon. W. F. King. Assistant J. F. Pratt, who had been assigned to duty in Mr. Tittmann's party was directed by him to cooperate with Mr. J. Gibbons, Dominion Land Surveyor, working on the north side of the river, while Sub-Assistant J. A. Flemer was instructed to join the Canadian party under Mr. C. A. Talbot, Dominion Land Surveyor, whose work was on the south side of the river.

The charge of the astronomical station at Fort Wrangell on Etolin Harbor, Wrangell Island, about 8 miles south of the mouth of the Stikine, was assigned to Sub-Assistant G. R. Putnam.

Mr. Tittmann has accompanied his report of the season's work by carefully executed diagrams of the triangulation from Fort Wrangell to Hunter's Post, on Rothesay Point, which was the initial point of the Canadian survey of the Stikine, made in 1876, and from the Great Bend of the Stikine to the reference post which he established to mark the distance of 10 marine leagues from this point. This reference post is about 5·4 kilometres from the lower mouth of the Porcupine, and about 2·3 kilometres above the waterfall of a small stream, which, coming out of a deep valley, falls into the Stikine.

In the course of the triangulation, base lines were measured at frequent intervals with a 50-metre steel tape, and azimuths were determined by observations on the sun at six stations between the Great Bend of the river and the mouth of the Porcupine. A junction was effected at the Great Bend with Mr. McGrath's triangulation, and a very satisfactory agreement found in azimuth as well as in distance. As soon as this junction had been effected, Mr. Tittmann returned to the upper part of the river and extended the triangulation from the mouth of the Porcupine to the point at which the reference post was established. He observes that the distance of 10 marine leagues is reckoned at right angles from a line passing through Hunter's Post and which, for the purposes of this calculation, was assumed to be parallel to the general direction of the coast line. The triangulation extended along the main channel of the river, and the triangle sides were necessarily very short, being on an average about 500 metres in length. During a large part of the time the mountain tops were shrouded in clouds, but all of the principal ones, visible from the river, were determined in position as well as altitude by their azimuths and zenith distances observed from various stations of the triangulation.

The topography was plotted and drawn by Mr. A. L. Baldwin, temporary aid, whose efficiency and energy in the performance of these and other duties assigned to him are heartily commended by his chief.

Several of the mountains determined fall outside of the limits of the topographical sheet, notably Kates Needles, the highest one observed, which is 3 034 metres (9 954 ft.) in height, and Pinnacle, 2 544 metres (8 345 ft.).

The principal topographic feature of the river between the Great Bend and the Ten League Post is the Great Glacier, which passes through a mountain gorge about 1·8 kilometres wide and then spreads out into a fan-shaped front over 6 kilometres in extent. Opposite to it, at the foot of a mountain, were found the Warm Springs, recorded by earlier explorers.

Mr. Tittmann observes that the views obtained of the Great Glacier make it certain that it extends at least 15 kilometres (about 9·3 miles) to the westward of its river front. Farther up the river, the glacier known as Dirt Glacier comes down, of which no survey could be made for lack of time. This appeared to be connected with the glaciers lying on the flanks of the mountains, whose serrated outline reaches its crest at the summit of Kates Needles, and the eastern face of which appears like a huge amphitheater when seen from the vicinity of Ten League Post.

With regard to the group of mountains to the westward of the Stikine, of which Kates Needles appears to be the highest, Mr. Tittmann observes that it overtops the mountains between it and the coast, and the same remark holds good of Big Mountain and Pinnacle to the eastward of the river. Whether the mountains still farther inland are higher than those mentioned he is unable to say, but is of the opinion that if this mountain region is to be regarded in a broad sense, as a range, its crest does not lie oceanward from these peaks.

On August 22, his party having completed its labors on the river, camp was struck and a start made down the stream with the intention of assisting, if necessary, Messrs. Ogden and McGrath, who had been surveying the lower reaches of the river. Finding that Mr. McGrath had about finished his work, and that Mr. Ogden had already gone to Wrangell, Mr. Tittmann went there also, and completed the connection between his own triangulation and that which had been made by the hydrographic parties near Fort Wrangell in preceding years.

To Mr. Tittmann's report is appended the one submitted to him by Mr. Flemer, who accompanied the Canadian party of Mr. Talbot on the south side of the Stikine. He made many ascents of mountain peaks with the Canadians; observed horizontal and vertical angles for determining their positions; referred them to panoramic views, and made sketches of the surrounding terrene by means of a small plane table and ruler with "pin" sights, representing the topography in horizontal projection.

Distances were estimated, and their true values will be found by combining these oriented sketches, after their stations have been plotted according to position and scale. All of Mr. Flemer's stations, as well as those occupied jointly with the Canadian party, were connected with Mr. Tittmann's triangulation of the mouth of the Stikine.

Mr. Flemer made a special study of the methods of photo-topography which had been brought to a high degree of development by the dominion land surveyors under the direction of the Surveyor-General, Capt. E. Deville, Hon. W. F. King, Canadian Boundary Commissioner, and Mr. O. J. Klotz, of the Dominion Topographical Survey, and he has accompanied his report by a full description of these methods and of the apparatus employed, with drawings and explanations.*

With regard to the statistics of work of the season, he reports that fifteen mountain peaks were climbed by himself (sixteen by Mr. Talbot); signals were built on all of them, and some peaks were ascended two or three times. Thirteen elevated stations were occupied with a surveyor's transit, and one with an azimuth compass; sixteen shore stations were occupied. About ninety plates were exposed from twenty camera stations, controlling an area of over 400 square miles. There were but twenty-four days during the season when the weather was favorable enough for work to be done; fifteen days were occupied in traveling and transportation, and there were fifty-seven days of bad weather.

Mr. Flemer has appended to his report a progress sketch of his topographic reconnaissance.

The report of Sub-Assistant Putnam, submitted to Mr. Tittmann, presents a carefully prepared and comprehensive statement of the several branches of field work assigned to his charge, with summaries of his results for chronometric longitudes, Fort Wrangell Station, east of Sitka; for time and latitude as determined with a meridian telescope; of trigonometrical work for the connection of the astronomical and magnetic stations, and of results for the values of the magnetic declination, dip, and intensity.

In addition to making the astronomical and magnetic observations, Mr. Tittmann reports that Mr. Putnam rendered most valuable aid to his party up the river by supplying stores, directing the construction and purchase of suitable boats, and in other ways attending to such wants as arose from time to time. He assisted in the needful computations, made observations of horizontal angles, and searched for some of the old triangulation points which had been marked by the hydrographic parties.

The several stations which he connected with the triangulation were the astronomical station of Assistant Davidson, occupied in 1869; the pendulum station occupied in 1891 by the Superintendent, and the magnetic station of Lieutenant Nichols, 1881.

For the chronometric determination of longitudes he obtained sidereal time observations on forty-seven nights, between May 12 and September 2, and secured in all one hundred and seven comparisons of chronometers, corresponding to twelve trips of the steamer *Hassler*.

During a visit to Sitka, he made observations with Mr. Morse for personal equation, and similar observations with Mr. Lord, who was temporarily in charge of the Fort Wrangell observatory.

Mr. Tittmann acknowledges the obligations of the Survey to Judge Kelly, United States Commissioner, who kindly placed two office rooms at his disposal; also to the United States Marshal, Mr. Thomas, who furnished storage rooms for the boats left at Fort Wrangell on the departure of the party homeward bound.

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*See also Appendix No. 3, Report for 1893, Part II, on Photo-topography as practiced in Italy and in the Dominion of Canada; an elaborate paper on this subject prepared by Mr. Flemer.

The statistics of the season, in tabular form, are as follows:

ALASKA–BRITISH COLUMBIA BOUNDARY SURVEY—STATISTICS OF FIELD WORK—STIKINE RIVER.

O. H. TITTMANN, ASSISTANT AND CHIEF OF PARTY.

Number of stations occupied at which horizontal angles were observed	200
Number of base lines (subsidiary) measured	13
Total length of base lines in metres	7 381
Number of stations from which vertical angles were measured	36
Mountains determined in geographical position	53
Number of square miles of detailed topography	160
Number of miles of shore line of main river surveyed	66
Number of miles of shore line of sloughs surveyed	14
Number of geographical positions computed	194
Number of solar azimuths observed	6

J. A. FLEMER, ASSISTANT.

Area of topographic reconnaissance in square miles	400
Number of peaks occupied successfully	14
Number of shore stations	16

G. R. PUTNAN, SUB-ASSISTANT.

Latitude:	
Number of pairs of stars observed	34
Number of observations	91
Number of nights	5
Chronometric longitude:	
Number of nights on which time was obtained	47
Number of days of observation of solar transits	15
Number of times of comparison with ship's chronometers	14
Number of nights on which azimuths were determined by micrometric measures	2
Number of nights on which personal equation was observed	3
Number of days on which magnetic elements were observed	3

Field operations were closed for the season early in September, 1893, and the officers of the party reported later in Washington, D. C.

Surveys on Holkham Bay and at the head of Port Houghton.—The progress of that part of the Alaska–British Columbia boundary survey which involved field operations on Holkham Bay and at the head of Port Houghton has been fully reported from the beginning of the season, early in May, 1893, to its close in September by Mr. Homer P. Ritter, expert observer, who had been assigned to duty as topographer to accompany a Canadian party.

An abstract of progress up to June 30, derived from Mr. Ritter's preliminary report, has already been published. On the 1st of July he was in camp on the south shore of Endicott Arm, the southeastern extension of Holkham Bay, the camp having been located opposite the narrow inlet called Fords Terror.

Ascents of the several mountain peaks in the vicinity were made whenever the conditions were favorable for securing topographic sketches, measurements of horizontal angles, or views with the camera, but the weather during July was no better than it had been during June, observations being possible on but three days during the month. On July 8, Peak No. 3 was finally occupied, eight ascensions having been made, and photographs, angles, and sketches obtained. After the occupation of an auxiliary station, Camera No. 1, on the west side of Fords Terror, camp was moved to the head of Endicott Arm. On the night of July 20, the weather having cleared up and remained clear during one day, observations were obtained in the vicinity of this camp. The chief of the Canadian party having decided to reoccupy Peak Station No. 1, camp was moved back to Sandford Cove, near the entrance of Endicott Arm, but no observations could be secured until August 5, when the clouds and fog partially cleared away for a few hours.

Next day the camp equipage was loaded on a sailboat, and a start made for the head of Port Houghton, distant by water 54 miles. The party had to row most of the distance on account of head winds, and to lie by at night because of thick weather.

On August 11, camp was pitched at the head of Port Houghton, and on the 19th and 20th two days' observations were obtained. Nothing could be done during the remainder of the month, and after waiting until the 31st for some favorable change in the weather, the party embarked September 2 on board the Canadian steamer *Thistle*, and arrived at Wrangell the next day. Mr. Ritter then took passage on the *Hassler* for Port Townsend, proceeding thence to Washington, D. C.

For July and August, 1893, he reports the following statistics:

Number of stations occupied from which angles and sketches were taken	6
Number of days on which observations were made	7
Number of days on which work could not be done on account of rain, fog, or clouds	54

Surveys on the Taku and Stikine rivers in connection with the location of the Alaska–British Columbia boundary line.—The advance toward completion of the survey of the Taku River on July 1, 1893, by the party in charge of Assistant Herbert G. Ogden was stated in the last annual report.

With regard to the triangulation of the river, Mr. Ogden observes that it may be divided into two sections: first, from the base line measured by Assistant McGrath at the mouth of the river to the check base at Kluchman Canyon, 15 miles higher up, and second, from Kluchman Canyon to the check base at the head of the triangulation, 7 miles distant. In the lower section, some lines were obtained of 3 or 4 miles in length; in the upper section the lines were all shorter, rarely exceeding a mile, so that for signals strips an inch square cut from boards were resorted to. An independent direction line was carried through the whole work, and checks upon the azimuth were also obtained by pointings on a mountain peak that afforded a definite object, and by measurement of an azimuth on the sun at one of the upper stations of the triangulation.

The check base at Kluchman Canyon was 430 metres long and agreed within 1–5 500 with the side computed from Mr. McGrath's base. At the head of the river the base was 400 metres in length and agreed within 1–10 000 part with the side computed from the Kluchman base.

A topographic sketch was made of the river on a scale of 1–40 000, embracing the shore line and mountain features that were visible from the river banks. The river bottom is generally about 3 miles in width, and from it the mountains rise abruptly, broken only by lateral valleys through which small streams flow into the river, except in case of the glaciers shown upon the sketch.

On the west bank of the river, about 8 miles above the mouth, two large glaciers making down from the interior, join just as they debouch into the valley. Mr. Ogden states that he has been unable to learn that any name has been given to this field of ice, and he suggests "Twin Glaciers" as an appropriate one. Farther up the river on the left bank, Wright Glacier, named by Dr. W. C. Hayes of the Geological Survey, is shown for several miles back from the valley.

Near the mouth of the river the mountain peaks were found to be from 3 000 to 4 000 feet high, and still higher as they are farther in the interior. The greatest elevation, 7 100 feet, shown on the sketch, is that of a peak just beyond the proposed location of the boundary. The mountains are generally wooded to an elevation of about 2 000 feet, and upon those that exceeded 5 000 feet snow rested during the entire summer.

The heights were determined with the alidade of the plane table. A number of these were checked from one station with the vertical circle of the Casella.

Mr. Ogden observes that as the main object of the work was to locate a monument on the banks of the river which should be 10 marine leagues distant from the continental coast line, he did not feel at liberty to take the time that would have been required to ascend any of the mountains with a view of sketching farther into the interior.

The banks of the river where the 10-marine-league line crosses were fortunately found to be reasonably stable, there being no indications that any washing of the banks from high water had taken place for years. To mark the 10-league limit, a small brick pier, a brick and a half square, was erected, resting upon a concrete foundation about 3 feet under ground, and showing about 2 feet above ground. This pier is probably not more than 100 or 200 metres beyond the boundary line. A second mark, consisting of a hewn log 18 inches square and 5 feet long, was set up about 400 metres nearer the coast than the brick pier. This log was also anchored with concrete, and it is believed that whatever line shall be taken as the continental coast line, a distance of 10 marine leagues will fall somewhere between these marks.

On the 9th of July, the triangulation of the river having been completed, Mr. Ogden returned next day to the astronomical station which he had established in May at the head of Taku Inlet. Mr. O. B. French, the observer in charge, had experienced much unfavorable weather, but by constant watching for clear intervals, had succeeded in securing observations in close connection with the exchanges of chronometer comparisons with the steamer *Hassler*. He had also observed for latitude with a meridian telescope, and determined an azimuth for the triangulation. As soon as the magnetic instruments were received, towards the end of July, he observed on four days for the magnetic declination, dip, and intensity.

Having been delayed at Sitka by bad weather, it was not till July 20 that the *Hassler* appeared in the inlet. Next day she landed Mr. Ogden and his party at Wrangell, where he was joined by Mr. Dickins, and made arrangements to cooperate with Mr. Tittmann in the survey of the Stikine River by taking up the triangulation at the mouth where the last-named officer had left off early in the season and proceeding up stream. By the 19th of August the work had been carried some 10 miles to a line of junction with the triangulation of Mr. McGrath who was working down stream. During this period Mr. Dickins completed a topographic sketch of the area covered by the triangulation. Running surveys through the sloughs and part of the Back River, made by Mr. Ogden's party, were subsequently transferred to Mr. Dickins's topographic sheet.

The triangulation was checked by two short base lines, independent of the base measured by Mr. Tittmann, and by a junction on the line brought down by Mr. McGrath from his base, the lengths derived from these check bases agreeing within 1–10 000th part.

Upon the completion of the work on the Stikine, Mr. Ogden returned to Wrangell with his whole party before the end of August, and while awaiting the arrival of the *Patterson* and the *Hassler* brought up his field notes as far as practicable and made the arrangements needful for storing part of his equipment, and for the transportation of the remainder to San Francisco. By September 3, upon the arrival of the steamers, all of the parties had congregated at Wrangell, and next day moved aboard the ships and sailed south. On September 30, Mr. Ogden reported in person at Washington to the Superintendent.

He has accompanied his report with the detailed reports of Assistants Hodgkins and Welker who had been assigned to duty in the Canadian parties in charge respectively of Messrs. Ogilvie and MacArthur, Dominion Land Surveyors. He transmits also a detailed report submitted to him by Mr. French of his astronomical and magnetic work.

Mr. Ogden observes that he can not speak too highly of the aptitude exhibited by Messrs. Hodgkins and Welker in the prosecution of their arduous duties, and says that their results have given an excellent conception of the intricacy of the mountain masses in the region examined, and indicate that there is no well-defined mountain range such as was evidently contemplated by the wording of the treaty.

It gives him pleasure to report the agreeable association experienced with Mr. A. Driscoll, Dominion Land Surveyor, who was attached to his party and who aided materially in the advancement of the work. He gave this officer every opportunity to ascertain the value of the work carried on by the Coast and Geodetic Survey, both on the Taku and the Stikine.

With regard to Mr. French he was greatly pleased by the interest which he manifested in the work and his diligence in its execution. The results he obtained will, he believes, more than justify the confidence placed in his ability. Mr. S. B. Tinsley, temporary aid, served in Mr. Ogden's immediate party, and proved to be a most acceptable assistant.

From the report of Mr. Hodgkins, on detached duty with the party of Mr. William Ogilvie, of the Dominion land survey, to the north of Taku Inlet, the following extracts have been made:

> On Monday, May 15, the field work of the party was begun by the ascent of the mountain which rises precipitously from the valley of Gold Creek, immediately to the north of Juneau.
>
> The day was clear, bright, and very warm; the temperature of the air at the summit, at an elevation of 3 600 feet above the sea, and just above a snow field 10 feet in thickness being 70° F. in the middle of the afternoon. In climbing the steep mountain side, especially while struggling through the tangled thickets and over the rough rocks of the first half of the ascent, the heat seemed of tropical intensity, and all of the party suffered considerably in consequence.
>
> Upon reaching the summit I obtained the barometric height, and made such sketches as the time at my disposal would permit. The Canadians built a cairn about 4 feet high to serve as a mark to observe upon.
>
> During the remainder of the month of May the party was occupied with a triangulation designed to determine the relative positions of the stations to be occupied with the camera. A base line 2 652 feet long was measured on the beach on Douglas Island, opposite Juneau, and a scheme of triangles starting from this base was extended to several of the mountain peaks near that town. The first photographs were taken on May 28 at Peak No. 1. Several days of bad weather followed. On June 5 Peak No. 2, and on June 6 Peak No. 4 were ascended, and the necessary observations were made at each point.
>
> Peak No. 2 is on Gastineau Channel, a little east of Juneau; No. 4 is several miles back of Juneau, at the head of Gold Creek, and sees both Gastineau Channel and Taku Inlet. The ascent was not especially dangerous, but there were some very steep slopes, and for the last 2 000 feet the climb was through soft snow.
>
> Bad weather prevented work until June 9, when Peak No. 5, a little to the northwest of No. 4, was ascended and a round of photographs taken.

Mr. Hodgkins goes on to state that on June 12 the party moved camp to a point on the north side of Gastineau Channel, a little east of the mouth of Sheep Creek, and about 4 miles from Juneau, and that they remained at this camp until June 30, waiting for clear weather to ascend one or two mountains in the vicinity, and that finally Mr. Ogilvie decided to move to the mouth of the Taku, in order to make a traverse of that stream if the weather conditions were such as to prevent the ascent of peaks for photographic purposes. Both at this camp and at the preceding, Mr. Hodgkins endeavored to do such independent work as was possible with his very limited instrumental outfit.

> Mr. Ogilvie arrived at Taku observatory on June 30, and camped with the Coast Survey parties already there. As the weather turned warm and clear, no attempt was made to survey the river, and on July 2 the party ascended Peak No. 6, between the Windom and Taku glaciers.
>
> The ascent was somewhat difficult, and the heat of the day and the swarms of insects encountered caused great annoyance. The summit was entirely covered with deep snow, but even there we found many mosquitoes. On this mountain we saw several mountain goats. From the summit I noticed a lake in a valley between the Taku Glacier and the river and touching the side of the glacier. On the 3d and 4th of July I visited and made a rough survey of this small lake which I called "Lake Surprise." The valley in which it lies was

> evidently occupied in comparatively recent time by the glacier, which must then have discharged its ice into the river by this course, as well as into the inlet by its main stream.
>
> A number of small bergs were floating in this lake, which is 150 feet above tide water, and which discharges a considerable brook.
>
> On July 7, the party ascended the mountain on the east side of the inlet, directly back of Taku Point, and called No. 7 by Mr. Ogilvie. On the next day the party moved camp to a point on the east side of Taku Inlet, about 10 miles below the mouth of the river. This new camp was in a little cove about 3 miles ENE. from Jaco Point, marked "Tent" on the hydrographic sheet. No work was done on the 9th, and on the 10th bad weather set in again. We had a greater rainfall at this camp than at any other period during the season.
>
> July 21 being a fine day an ascent was made of Cooper Peak, on the west side of the inlet, several miles below camp. This was No. 8 of the series. The next day was stormy, and the bad weather lasted till August 5, on which day we ascended Peak No. 7, lying back of our camp. It was a hard climb. The first 2 000 feet were densely wooded and the slope was unusually steep and slippery. The upper slope was less troublesome, but as the summit was about 4 600 feet above camp, the ascent was quite laborious.
>
> On August 6, camp was moved to the old location at Sheep Creek, where the party remained till August 18, during which time Mr. Ogilvie made a traverse survey from his station opposite camp to Marmion Island, and took a number of photographs at points near the sea level.

Between August 18, when camp was moved to a point on the mainland about 6 miles northwest of Juneau, and August 24, when Mr. Hodgkins went with the party to Juneau, and finding the *Hassler* there, was authorized to take passage in her to Sitka to meet the *Patterson*, two more mountain peaks were ascended; on one of them the timber line was much higher than usual, having an elevation of 2 500 feet.

Mr. Hodgkins has submitted also a supplementary report, which is of much interest, as it gives the impressions of a skillful and experienced topographer relative to the country examined during the season, with special reference to the location of the international boundary:

> The work of the season covered about 599 square miles of territory, inclosed within a nearly equilateral triangle.
>
> All of this region was full of mountains, but I could see no indication of a dominating or nearly continuous range anywhere near the coast line.
>
> The mountain peaks are from 3 000 to 5 000 feet in height, with a general tendency to greater elevation above the head of Taku Inlet.
>
> The whole area is a network of short, steep ridges, generally lying approximately at right angles to the nearest shore, and connected by short saddles nearly as high as the peaks. This formation seems to indicate that these ridges and valleys are the results of local influences of erosion by inland waters. Farther back from the shore, where ice and dry cold are the principal eroding influences, the peaks project sharply from the envelope of snow and ice which stretches downward on their flanks to form countless glaciers, large and small.
>
> Far back in the country to the northward could be seen the peaks of lofty mountains which lie about 25 miles to the northward of the mouth of the Taku River. Whether these peaks are a part of the backbone of the mountain system of this coast, or not, I am unable to say, but this at least is clear, that from every mountain ascended by Mr. Ogilvie, higher mountains could be seen to the northward. Nowhere did he attain the summit elevations of the system.

Sub-Assistant Welker, who was a member of Mr. Ogden's party, was detailed to accompany the Canadian topographic party in charge of Mr. J. J. MacArthur, Dominion Land Surveyor, and was instructed to make such reconnaissance, based on angular measurements and magnetic bearings, and checked by such astronomical observations, as might be found practicable and will serve to form a just estimate of the value of the survey made by the Canadian parties, and for the location of mountain peaks and ranges, if the latter should be found to exist.

Mr. Welker joined the Canadian party on May 11, at the entrance of Endicott Arm of Holkham Bay and cooperated with them in their survey of the interior of the country between Holkham Bay and the Taku River. For transportation of party and camp outfit, there was one canoe about 15 feet long and one sailboat about 30 feet long and 7-foot beam. The canoe alone was suitable for transportation from camp to the field work.

Mr. Welker observes that the shores are very steep and rocky, and landing places are scarce, especially about Holkham Bay, where in numerous places rocky cliffs rise almost perpendicularly from the water's edge to the height of 3 000 feet and over. The waterways are deep, and the currents very swift. In the smaller streams, where navigation was only possible with the canoe, tracking being necessary in many places, the currents run from 5 to 12 miles per hour. Almost the entire interior of the country is covered with glacier-bearing mountains, which are from 2 000 to 7 000 feet high. The timber line varies from 1 000 to 2 500 feet in elevation.

The slopes of the mountains facing the waterways are covered with a dense growth of spruce and cedar. The underbrush is very thick, and the surface of the ground for about one-half the distance to the timber line is covered with a thick moss.

Upon the arrival of the party at Holkham Bay, the entire surface of the ground for some distance below timber line was covered with snow from 3 to 20 feet deep.

The photographic method was used by the Canadian representatives in their explorations of the country. This method involved the making of a rough triangulation having sides of from 3 to 8 miles, and the taking of a set of photographs of the surrounding country from each station with a leveled camera of a constant focal length. Observations were generally made upon mountain peaks; no signals were erected, but occasionally a pile of rocks was used as a distinguishing point. A 3-inch instrument was used for the triangulation and the determination of heights. Negatives were taken upon glass plates to be developed later, and from which photographs would be printed and enlarged. From these enlargements a geometrical projection on a plane surface was eventually to be constructed by the usual methods of photogrammetry.

The first ascent was made on May 24, 1893, and on this date the field work was begun. The method was to follow the waterways with the sailboat and canoe, establishing rough camps as near as possible to the base of certain mountains where peaks had been selected for observation stations. The ascents would necessarily be made on foot, and were usually very difficult on account of fallen timber and dense brush, deep snow, glaciers, and rocky cliffs. During the season eighteen ascents of mountain peaks, ranging from 2 100 to 7 000 feet in height, were made, from all of which horizontal angles and photographs were taken. Photographs were also taken from numerous prominent points on the main shore and on the islands.

The course pursued was first a short distance up Endicott Arm, where the work of Mr. MacArthur and Mr. Brabazon joined. Next the party went up Tracy Arm to within 6 miles of the head. From this point to the base of the glaciers at the head was one mass of ice, and it was impossible to go farther in that direction. The party next went up Snettisham Bay and explored the mountains bordering the Whiting and Speel rivers for a distance of about 30 nautical miles from the main shore. Stephens Passage and Taku were then followed up as far as the head of the inlet, and observations and photographs were taken from a number of peaks and triangulation points along the line.

One hundred and eighty negatives were taken, covering the country between Holkham Bay and the Taku River for a distance of approximately 30 nautical miles from the main shore line. When photographs have been printed from these, and the horizontal projections have been made by the usual methods, it is supposed that a fair representation of the country in regard to existing mountain ranges, their direction, heights, and, roughly, their shape will be obtained.

Mr. Welker states that the condition of the weather during the season, which was generally rainy or misty, prevented rapid progress of the survey. From the time of beginning field operations May 24, to the time of closing, September 1, there were but twenty-two working days, and many of these were unsatisfactory for good work. The time for observations at a station would range from fifteen minutes to two and one-half hours. One hour at a station would be a fair average.

Mr. Welker's time was mainly employed in obtaining data for the primary object of the survey, the locating of prominent peaks, and the direction of mountain ranges. His instruments were a 2¾-inch Casella theodolite, a small sketch board, and an aneroid barometer. At each station he measured a round of angles upon prominent peaks. These peaks were then located and their positions were plotted upon the published charts of the locality. From these positions as a base the directions of the ranges and of the water courses were roughly sketched. Enough data was secured in this way to show the general character of the topography of the country, and to check the photographic survey made by the Canadians.

Although the results obtained show spurs of mountain ranges running in almost all directions the entire country explored is really covered by one immense connected mountain system, and the highest peaks, which are probably the backbone of the system, are from 20 to 30 miles farther inland than the inner limits of the country explored.

Mr. French, observer in charge of the Taku astronomical station, reports that every care was taken to keep the chronometers at as uniform a temperature as possible. They were compared regularly every morning, and, whenever an observation for time was obtained, the temperature inside and outside of the chronometer box, and the reading of an aneroid barometer was taken.

Comparisons were made with the chronometers transported by the steamer *Hassler* on seven different occasions; the following method being employed: First, the station hack was compared with the two standard chronometers at the station by both the observer and the recorder who was in charge of the chronometers on board the *Hassler*; it was then taken on board the steamer and compared in a similar manner with the steamer chronometers, and finally brought back and recompared with the station standards as a check against the possible tripping or dropping of a beat during the transportation to or from the ship.

Observations of latitude with a meridian telescope were begun May 25, but owing to constantly recurring periods of cloudiness were not finished until July 7.

The azimuth of the mark used in the triangulation of Taku Inlet and River was determined upon two clear nights.

Mr. French acknowledges the cordial assistance which he received in the observatory work at various times from Assistants Hodgkins and Welker, and from Mr. Tinsley.

For the season Mr. Ogden has reported statistics as follows:

ALASKA BOUNDARY WORK, H. G. OGDEN, ASSISTANT.

	Taku River.	Stikine River.	Total.
Base lines:			
Secondary, length of, in metres	846·1	975	1 821·1
Number of days employed in base measurements	2	2	4
Triangulation:			
Area of, in square statute miles	68	34	102
Number of stations occupied for horizontal measures	56	27	83
Number of stations occupied for vertical measures	67	29	96
Latitude, longitude, and azimuth work:			
Number of latitude stations occupied			1
Number of pairs of stars observed for latitude			33
Average number of observations on a pair			3·2
Longitude stations, chronometric, number of days on which comparisons were exchanged.			7
Number of stars observed for azimuth on two nights			2

Topography:

Area surveyed in square statute miles (topographic sketch)	183
Length of shore line of rivers in statute miles	57
Topographic sheet of Taku River below the boundary (scale 1–40 000).	

STATISTICS REPORTED BY W. C. HODGKINS, ASSISTANT.

Number of square miles of topography surveyed (approximate)	500

STATISTICS REPORTED BY P. A. WELKER, ASSISTANT.

Number of square miles of topography surveyed (approximate)	1 500
Number of stations occupied for horizontal angles	18
Number of points located	26
Number of camera stations occupied	42
Number of photographic negatives obtained	180

Alaska boundary work.—Completion of the surveys of Taku Inlet and of the Stikine River.—The progress of field operations on Taku Inlet by the Alaska Boundary party, in charge of Assistant J. E. McGrath, to June 30, 1893, was stated in the last annual report. At that date the survey of the inlet was practically complete. The first day of July was occupied in the measurement of some additional vertical angles, and in making a survey of a newly discovered lake, which had not hitherto been delineated on any of the Coast and Geodetic Survey charts. This accomplished, preparations were made for the transfer of the party to the Stikine River, and upon the arrival of the steamer *Hassler*, July 2, all of the camp outfit and instruments were put on board, and on the evening of that day the steamer left for Wrangell. Upon his arrival at Fort Wrangell next day, Mr. McGrath met there Mr. Tittmann, and conferred with him as to the best method of reaching the locality on the Stikine where it was deemed advisable that his party should take up the triangulation.

Finding that the dories belonging to his party would be almost useless in the rapid waters of the Stikine, except for carrying freight down stream, Mr. McGrath ordered the construction of bateaux, and learning that the most expeditious way of reaching his working ground would be to take passage on the stern-wheeled steamboat which navigates the river, he left in her on July 8, and next day landed in the vicinity of the point where his work was to begin.

Mr. McGrath observes that the river was on a rise at this time, but he was assured by the owner and by the captain of the steamboat, both of whom had had many years' experience on the Stikine, that the highest stage was almost reached, and that after it there would be low water for the rest of the season. Events proved that this prophecy was a mistaken one, and indicated that the stream is very erratic in its movements.

Unless the mountain peaks could be occupied, a low stage of water is a necessity for rapid and economical work. Then the sand bars appear in every direction, and bare points make out from all of the bends. On the bars camps can be established and bases measured; signals can be erected on these bars and on the exposed points of the river bends, and since the lines are short, the occupation of a station is a matter of but little time. If, however, the river is high, all of these favorable conditions disappear; nothing is visible but the main banks, which are covered with a dense growth of alders and cottonwood to the very edge; lines of but a few hundred metres in length can be seen only at an expense of great labor and time by cutting lanes through this growth, and as the banks are being incessantly washed away, signals and cleared lines disappear (in some instances) in a few hours, and the work must be done over and over again.

Mr. McGrath states that if the reports of his Indian informants, and of the traders and prospectors who had lived for years on the river, were correct, the season of 1893 was a very remarkable one. Flood after flood occurred, the rain might almost be described as a continuous one, and the cloudy sky and cloud-capped condition of the mountains seemed to be all but permanent. Between the 9th of July and the 25th of August there were twenty-eight rainy days, and only five days when for about half of the time the sun was visible.

He is of the opinion that this condition is not general for the entire river, but that it is confined to the stretch between the coast and the Big Bend of the Stikine, because he was informed by hunters and by the steamboat men that when they passed the Big Bend going up stream they found fine and clear weather, and that this lasted all through their stay on the upper river, but that when they passed the bend going down they entered into a cloudy and rainy belt.

In connection with the triangulation, bases were measured near its beginning and its close, and junctions made with the work of Assistants Tittmann and Ogden. (See abstracts from the reports of these officers under preceding headings.) Big Bend base, between stations Monimia and Aurelia was measured July 19, and the final base before the close of the work and near the Popoff Glacier on August 21.

The party then returned to Fort Wrangell and went into camp there, awaiting the advent of the steamers which were to transport it to Puget Sound. On September 25, Mr. McGrath disbanded his party at San Francisco, and next day left for Washington, D. C.

He makes cordial acknowledgment of the valuable and effective service rendered by Sub-Assistant F. A. Young, who took the greatest interest in the advancement of the work, and was always a hard working and zealous officer.

The following are the statistics of field operations from July 1 to the close of the season:

Reconnaissance:	
Area of, in square miles	63
Lines of intervisibility determined	85
Number of points selected for scheme	35
Base lines:	
Secondary, length of, in metres, No. 1,	495
Secondary, length of, in metres, No. 2,	600
Triangulation:	
Area of, in square statute miles	63
Number of signal poles erected	39
Number of stations occupied for horizontal measures	35
Number of stations occupied for vertical measures	1
Number of geographical positions determined	35
Number of elevations determined trigonometrically	2
Azimuth work:	
Number of azimuth stations	1
Number of days on which observations were made for azimuth	3
Topography:	
Area surveyed in square statute miles	28
Length of shore line of rivers in statute miles	55

Resumption of the boundary survey between Alaska and British Columbia in the spring of 1894.—The instructions issued for the continuation of the international boundary survey between Alaska and British Columbia contemplated that the following parties should take the field: Assistants Pratt and Flemer and Mr. Ritter were to conduct parties around the head of Lynn Canal. They were to be joined by Assistant Dickins as soon as the latter had finished the reconnaissance of the Unuk River which he had been directed to continue from the point at which operations ceased last summer.

Assistant Morse was again to occupy the astronomical base station at Sitka for the comparison of time by means of chronometers carried to and from Pyramid Harbor by the steamer *Hassler* under the command of Lieut. Giles B. Harber. Assistant J. E. McGrath was to take up the survey of the coast from Cape Manby toward Icy Cape and to perform some additional work at Lituya Bay. The *Patterson*, Lieut. Commander W. I. Moore, and the *Hassler*, Lieut. Giles B. Harber, commanding, left Port Townsend on April 28, carrying the parties to Alaska. The former ship landed Mr. Dickins's party at Burroughs Bay and Mr. McGrath's near Cape Manby in Yakutat Bay. The other parties were carried by the *Hassler* to Pyramid Harbor and Sitka.

Astronomical and magnetic observations at Sitka.—On the resumption of the boundary surveys in the spring of 1894, Mr. Morse was again ordered to Sitka, as above stated, to occupy the base astronomical station while the *Hassler* carried chronometers between Sitka and the Pyramid Harbor observatory. Mr. James Page had charge of the chronometers on board the *Hassler*. Between May 12, the date of Mr. Morse's arrival at Sitka, and the end of June, two round trips had been made. The time which would have been occupied in making another was taken up in transferring Assistant Dickins and his party from Burroughs Bay to Chilkat. During her trips back and forth the *Hassler* stopped at Freshwater Bay where Lieut. Commander Moore of the *Patterson* had established an astronomical station in connection with the survey of Chatham Strait, and made chronometer comparisons at that station to determine its longitude.

The point at which, as previously stated, magnetic observations were made during August of last year was again occupied by Mr. Morse, and the magnetic elements were determined on May 22, 23, and 24.

Completion of the reconnaissance of the Unuk River.—Assistant E. F. Dickins was instructed to continue the survey of the Unuk River from the point reached by him last season as far as the 10-marine-league limit, Mr. S. B. Tinsley, temporary aid, was assigned to duty under Mr. Dickins.

The *Patterson*, having Mr. Dickins's party on board, reached Burroughs Bay on the 7th of May and landed them. For five days after landing a storm of snow, hail, and rain prevailed, and when it ceased, on May 13, the start up the Unuk was made. The water in the river was found low and the gravel bars and the banks were covered with snow and ice from 6 to 8 feet deep. By walking on top of the frozen snow and towing the canoes good progress was made and 9 miles were covered on the first day. On the 16th the first canyon was passed in a few hours, while during the previous season the passage consumed two days; on the evening of the 17th the mouth of the second canyon, where the Canadians had stopped work the previous season, was reached. Up to this time the weather had been cold, but as the temperature rose the snow became soft and difficult to walk upon and the river began to rise. The second canyon, however, was successfully passed and by the 19th the gap between the second and third canyon had been completed. The current in the third canyon was found to be too swift to be entered with the boats and the traverse had to be run along the top of the cliffs. On account of the deep, soft snow and the heavy timber, progress became very slow, but the goal was finally reached and the last station was referred to four large hemlock trees suitably blazed and marked with copper tacks.

The rising of the river constrained Mr. Dickins to start down stream as soon as possible. Messrs. Dickins and Tinsley and one man led the way in a small canoe, the others following. In rounding a sharp curve the canoe struck a sunken log and capsized, throwing its occupants into the icy water, but happily they were able to save themselves after a severe struggle; some instruments and baggage were lost. After resuming their journey and after another accident, which resulted in the smashing of a boat and the loss of some of their equipments, the party reached Burroughs Bay. Leaving this place in a whaleboat, the party went to Loring where they remained until the *Hassler* arrived and took them aboard on June 7. At Sitka Mr. Dickins purchased supplies to take the place of those lost on the Unuk and on June 16 his party was landed at Pyramid Harbor and went into camp and began a topographical reconnaisance of Chilkat Inlet, connecting with Mr. Ritter's work.

Triangulation and topographic reconnaissance of Chilkat and Taiya inlets.—To Assistant J. F. Pratt was assigned the duty of making the survey of Chilkat and Taiya inlets to the

10-marine-league limit. Sub-Assistant F. A. Young; J. F. Hayford, aid; A. L. Baldwin, temporary aid, and T. C. Taylor, recorder, were directed to report for duty to Assistant Pratt.

On May 14, materials and camp equipment were moved ashore from the *Hassler*, and the building of the observatory was begun at a point about 1 mile south of Pyramid Harbor. On the next day the party went ashore to live, and on that night good observations for time were obtained by Mr. J. F. Hayford, aid, who made the astronomical observations at this station throughout the season.

The triangulation was commenced in Chilkat Inlet on May 17, and carried from abreast the Davidson Glacier up the Chilkat Inlet and River to a point about 3½ miles above Kloquan, the Chilkat's upper village.

Five bases were measured with a steel tape, and the direction of the network of triangles was controlled by a series of long azimuth lines. The solar eclipse astronomical station of 1869 at Kloquan was found in perfect condition, and was connected with the triangulation. A topographic sheet, scale 1–40 000, covering about 130 square miles in the vicinity of the 10-marine-league limit was also completed.

Magnetic observations for declination were made at Kloquan with a compass declinometer, and at the astronomical observatory with the filar declinometer and dip circle. At the astronomical observatory observations for time, latitude, and azimuth were made and chronometric comparisons for difference of time from Sitka were obtained on each return of the *Hassler*.

Topographic reconnaissance to the northward and eastward of Taiya Inlet and River.—The mapping of this region was assigned to Assistant J. A. Flemer, who went into camp at the mouth of the Khatsehin Valley on the east side of Chilkoot Inlet on May 19, with the two men who constituted his party. Having measured a base for the plane-table triangulation he made several attempts to run a traverse line up the Khatsehin Valley, but owing to the snow, the swollen condition of the river, and the swift current it was found impossible to advance up the valley at that season of the year. During this time a plane-table triangulation was carried up the Chilkoot Inlet to the mouth of Taiya Inlet. Owing to his small force of men Mr. Flemer was compelled to use a small Peterborough canoe and as the water of Chilkoot Inlet was often very rough, the use of the canoe was attended with difficulties and dangers.

Before the end of June Mr. Flemer obtained topographic photographs from Mount Ripinsky, which is 4 300 feet high, and had completed a topographic sheet on a scale of 1–80 000.

Topographic reconnaissance to the northward and westward of the Chilkat Inlet and River.—Mr. Homer P. Ritter, who during the previous season was engaged in the vicinity of Holkham Bay, was directed to carry on a topographic reconnaissance to the northward and westward of the Chilkat Inlet and River. He landed at Pyramid Harbor on the 15th of May and began the work assigned to him on the following day at Pyramid Harbor, going up Chilkat Inlet and River and taking in the topography to the eastward and westward and making side excursions when practicable. By the end of June satisfactory progress had been made.

Survey from the south end of Malaspina Base to the delta of the Yahtse River.—The survey of this locality was intrusted to Assistant J. E. McGrath; when his party was landed on the beach at Yakutat Bay on May 22, he found a condition of affairs which ordinarily can only be paralleled in midwinter.

The whole country was buried under a heavy covering of snow with the exception of a narrow strip of beach extending from ordinary low-water to ordinary high-water mark. Camp was pitched about one-third of a mile from the Osar River on a narrow ridge, which on account of its exposed position was less deeply covered with snow than the surrounding country. The Osar was still frozen hard and fast except where it discharged into the bay. Fuel was procured from a spruce forest close at hand. When the party returned to this spot later in the season it was found that the stumps of trees which had been cut off at the snow line were from 6 to 12 feet high, showing the depth of the snow which prevailed when Assistant McGrath landed.

As soon as the condition of the beach allowed it a reconnaissance was made of the shore to within about a mile and a half of the Sitkagi Bluffs, to ascertain what preparations would be necessary for a further advance to the westward. It was found that rapid progress could not be hoped for until the snow should begin to disappear, as in many places driftwood was the only available source of fuel supply and it was hidden under the snow.

The beach was found well adapted for accurate measurements, being flat and giving long stretches for each section. The work progressed as rapidly as the bad weather would permit, and by June 13 the Sitkagi Bluffs had been reached. From this point men were sent back to bring up provisions in the large boat outside, and this was safely accomplished just before the surf began to get bad. After measuring about 3 miles westward from the camp at the bluffs and as soon as the sea moderated, camp was moved by boat around the bluffs while Mr. McGrath and Dr. Edmonds and two men carried the instruments and records around by land. The first trip of the boat was safely made; in landing the second time, however, the boat was capsized by a heavy breaker and all hands were buried under it, but it was righted by a second wave and all the men reached the shore and saved the boat. They then took many risks to save the provisions and other property and succeeded so well that the actual loss was trifling. On June 20, the measurement around the bluffs was completed and on the 27th work was begun on the base line. On the 21st of June the first band of Indians arrived on their annual sea-otter hunt, but for over a week they were unable to proceed on account of the surf and of bad weather.

Mr. McGrath was ready to observe Mount St. Elias from the ends of his base by June 27, and although the mountain was watched from 4 a.m. until late at night, the clouds which hung around its summit prevented observations until July 9; on that and the following day angles involving the mountain were measured many times by repetition. In the meantime, as the party was running short of provisions and was living largely on seal meat, Mr. McGrath dispatched the boat to Yakutat for supplies and with orders to get one of the largest sized Hydah canoes to bring provisions and to carry the party back to camp near the Osar. It was arranged that the Indian boat should start from Yakutat after Mount St. Elias had been visible for two days. The mountain was seen from Yakutat on the afternoon of July 8, and all day on the 9th while to Mr. McGrath, who was so much nearer to it, it did not become visible until 8 o'clock on the evening of July 9. Acting on the agreement the Indian canoe reached Mr. McGrath on the morning of July 10.

Embarking in the canoe with his men he reached the camp on the Osar on the 11th at 3 o'clock in the morning. While running the traverse line all the notable topographic features were cut in and sketched, and a satisfactory delineation of the coast between Cape Manby and Icy Cape was obtained.

Automatic tide gauge at Honolulu, Hawaiian Islands.—Through the courtesy of the Hawaiian Government Survey this Office was furnished with their automatic tide-gauge record at Honolulu, for the year, making a continuous record since 1891. Mr. Curtis J. Lyons has been in charge of the gauge.

ABSTRACTS OF ANNUAL REPORTS FROM THE ASSISTANT IN CHARGE OF THE OFFICE, THE HYDROGRAPHIC INSPECTOR, THE DISBURSING AGENT, THE ASSISTANT IN CHARGE OF STATE SURVEYS, AND THE ASSISTANT IN CHARGE OF THE OFFICE OF STANDARD WEIGHTS AND MEASURES.

ABSTRACT OF THE ANNUAL REPORT OF THE ASSISTANT IN CHARGE OF THE OFFICE.

The annual report of Mr. B. A. Colonna, Assistant in charge of the Office, transmitting the reports of the chiefs of the several divisions of the Office is given in full as Office Report No. 1.

During the absence of the Superintendent on other official duties, Mr. Colonna performed those of acting Superintendent.

He refers to the death of Assistant Spencer F. McCorkle, who had been in charge of the Engraving Division from July until October, and who died March 20, 1894; to the death on September 22, 1893, of Mr. John G. Thompson, engraver, the loss of whose skill in his art will be greatly felt by the Survey; and to that of Mr. Robert T. Basset, an old and trusted employee of the Survey, who died in February, 1894.

The Computing Division has, as heretofore, remained under the charge of Assistant Chas. A. Schott. The duties performed by the personnel of this division are given in full in his report. Special mention is made of the discussion of the results of observations made at San Francisco for determining the variation of latitude, and of the results of chronometric longitude determinations between Tacoma and Sitka, Sitka and Yakutat, and Sitka and Taku, Fort Wrangell and Burroughs Bay. In addition to his other duties, Mr. Schott continued to serve as examiner for the United States Civil Service Commission.

The report of the Tidal Division is submitted by Mr. L. P. Shidy, acting chief; Assistant G. A. Fairfield, who had been in charge, having been transferred to take charge of the Engraving Division on June 8.

In the tide tables prepared for 1895, important changes were made, particularly in the volume for the west coast. Full predictions were made for the first time for Honolulu and Panama, and the tides are given for the most important ports on the west coast of South America, in eastern Asia, Australia, and the islands of the Pacific Ocean.

The data given in our tide tables now relate to about half the seacoasts of the world, and it is contemplated to extend the predictions to all the principal commercial ports. With a view to enlarging their usefulness in this direction the honorable Secretary of State, at the request of the Department, addressed a circular letter to the diplomatic and consular agents of the United States, asking them to procure from the foreign governments to which they were accredited, replies to certain questions relating to tidal data, and much valuable information was obtained in response.

The progress of the reductions of accumulated tidal records is described, and attention is called to the necessity for a larger working force in the Tidal Division.

Assistant W. H. Dennis, in charge of the Drawing Division, reports that drawings were completed for twenty-six new charts, and for thirteen new additions of charts for engraving. In addition to this work, the time of the division was principally occupied in making drawings for the annual report of the Superintendent, projections for hydrographic and topographic field parties, applying new corrections to charts, inking original plane-table sheets, and in supplying information in response to calls from the general public.

The report of the Engraving Division is submitted by Assistant G. A. Fairfield, who took charge of it on June 9, in place of Assistant H. G. Ogden, who was ordered into the field. The most important engravings completed during the year were Chart B—Chesapeake Bay to Jupiter Inlet, scale 1–1 200 000, and Chart C—The Straits of Florida and Approaches, scale 1–1 200 000.

The report gives statistics of the output of work of the division under the headings: Engraving, Electrotyping, Photographing, and Printing.

The chart division has remained under the direction of Assistant Gershom Bradford. The issue files of the division have been increased by editions of six new charts from copper plates, and of eighteen new charts from stone. A new edition of the chart catalogue is in press. A comparative table given in his report indicates a decided decrease in the annual sales of charts over those of the five years immediately preceding.

The chief of the Miscellaneous Division, Mr. M. W. Wines, furnishes a report on the sale agencies for charts and publications, on the distribution of annual reports, appendices, bulletins, and Notices to Mariners. The following publications were sent to press through the Miscellaneous Division:

United States Coast Pilot; Atlantic Coast Pilot V—from New York to Chesapeake Bay Entrance; Tide Tables for the Atlantic Coast of the United States for the year 1895;

Catalogue of Charts and other publications, 1894; General Instructions for Hydrographic Parties; Bulletins Nos. 28, 29, and 30; Notices to Mariners Nos. 168 to 180 inclusive, and Appendices Nos. 1 to 12 inclusive, to the Annual Report of the Superintendent, to be printed separately in pamphlet form.

Assistant Edwin Smith remained in charge of the Instrument Division. His report shows the activity of the division by tabular and descriptive statements concerning the construction of new instruments and the repairs of old ones; the work done for the Office of Weights and Measures, the acquisition of new instruments and of miscellaneous work done for the Office. Reference is made to an ingenious device, invented by the chief instrument maker, by means of which the action of the air pump used for exhausting pendulum receivers is very much improved.

Mr. F. H. Parsons, chief of the Library and Archives Division, reports progress in arrangement and binding of a large number of volumes of tidal, hydrographic, and geodetic records. In the library, 12 211 volumes have been registered, and all books, except Government publications, have been catalogued, and many broken sets of publications have, by special effort, been completed. A valuable series of Japanese and French maps were presented to this Office at the close of the Chicago Exposition, and are now accessible in the library. During the year an effort was made to collect official State maps, but owing to the paucity of material but few States were able to respond to a request bearing upon the subject addressed to their respective governors.

ABSTRACT OF THE ANNUAL REPORT OF THE HYDROGRAPHIC INSPECTOR.

The Annual Report of the Hydrographic Inspector is submitted by Lieut. Commander Jeff. C. Moser, U. S. N., who at the beginning of the fiscal year was acting in place of Lieut. Commander Ackley, then absent on duty in Alaska, and whom he succeeded as Hydrographic Inspector on October 30.

The report reviews the hydrographic operations on the Atlantic and Pacific coasts and the work of the Hydrographic and Coast Pilot Divisions of the Office. An account is given of the repairs which were made on the vessels of the Survey, and those which will be required for the future maintenance are considered. The *Hassler* has been pronounced unsafe for outside work, and her condition is such that it is not considered for the best interests of the Government to make extensive repairs on her. With the exception of the *Patterson*, all the vessels of the Survey are old and will require a larger expenditure for repairs in the future. Suggestions, in connection with proposed work, are submitted in regard to a vessel capable of encountering the boisterous weather of the North Pacific. Special stress is laid on the necessity for extended and systematic current observations along our coasts.

The report of the Hydrographic Division is submitted to the Inspector by Lieut. Walter McLean, U. S. N., Assistant. He refers to the value in the preparation of charts, of the information furnished by the United States Engineers concerning improvements along the coasts, made under their supervision.

The monthly Notices to Mariners are prepared in this division; original hydrographic sheets are plotted, and drawings of hydrography are verified, and proofs of charts revised.

The Coast Pilot Division, involving work both in the field and office, was in charge of Lieut. E. H. Tillman, U. S. N., Assistant, until June 16, 1894, when he was detached by order of the Navy Department. His efficient services are highly commended by the Hydrographic Inspector.

During the year, Parts III and V of the Atlantic Coast Pilot were published and other parts were revised. Lieutenant Tillman recommends a reduction in the number of copies of the editions of the Coast Pilot.

A tide and current chart for Nantucket and Vineyard sounds was devised by Lieutenant Tillman and Mr. John Ross, and has received favorable comment by seafaring men to whom copies were submitted for criticism.

The Hydrographic Inspector refers to the death of Lieut. Chas. F. Emerich, U. S. N., Assistant, at Mare Island on February 4, 1894 Lieutenant Emerich had served as Executive Officer of the *Hassler* in Alaska in 1893, and had been selected and designated to assume command of the *McArthur.*

ABSTRACT OF THE ANNUAL REPORT OF THE DISBURSING AGENT.

This report, published as Office Report No. 3 is submitted by Mr. R. J. Griffin, Disbursing Agent, and contains a detailed statement of all the expenditures made for the Coast and Geodetic Survey during the fiscal year.

ABSTRACT OF THE ANNUAL REPORT OF THE ASSISTANT IN CHARGE OF STATE SURVEYS.

The report submitted by Assistant George A. Fairfield reviews the progress made in New Jersey, Tennessee, and Minnesota, the only States in which triangulation was being carried on for the benefit of the State, in accordance with the provisions of law.

ABSTRACT OF THE ANNUAL REPORT OF THE ASSISTANT IN CHARGE OF THE OFFICE OF STANDARD WEIGHTS AND MEASURES.

The preparation of five sets of standards intended for States which have not yet been furnished with copies of national standards, and comparisons of weights and measures with the United States standards for other branches of the Government and for colleges, surveyors, manufacturers, and others occupied the time of this Office.

A bulletin, approved by the Secretary of the Treasury, was issued in December, 1893, by the Superintendent, announcing the formal adoption by this Office of the names and values of units of electrical measure as defined by the International Congress of Electricians of 1893.

The report is submitted by Assistant O. H. Tittmann.

SUPERINTENDENT'S OFFICE.

Several officers performed duties at the Office in Washington under the immediate supervision of the Superintendent. Assistant G. A. Fairfield, in addition to his other duties, had charge of State surveys; Assistant O. H. Tittmann of the Office of Standard Weights and Measures during the intervals between field duty; Assistant Andrew Braid acted as executive officer to the Superintendent, and efficiently performed the manifold and responsible duties entrusted to him by the latter; and Assistant Edward Goodfellow prepared the Annual Report and edited it and other publications of the Office.

Mr. W. B. Chilton, in addition to his clerical duties, prepared the index for the Report of 1893, and Mr. Martin Hensel performed the duties of secretary of the Superintendent.

Mr. John W. Parsons, who had efficiently performed the duties of disbursing officer for many years, resigned on March 1, but before doing so prepared a paper, by request of the Superintendent, on the relations between the operating department and the accounting system of the Survey, which is published in the proceedings of the Geodetic Conference in the last Annual Report.

SUB-OFFICES.

Sub-office in Philadelphia.—The Sub-office in Philadelphia remained closed during the absence in the field of Assistant R. M. Bache, in whose charge it has remained during the fiscal year.

Sub-office in San Francisco.—Assistant George Davidson had charge of the Sub-office, except while absent on other duty. During his attendance on the Geodetic Conference in Washington, from January 1 to March 15, Assistant A. F. Rodgers was placed in charge. The latter, together with Mr. F. Westdahl, of this service, and Capt. W. C. Coulson, of the Revenue Marine, who kindly consented to serve, were constituted a board to examine all the property stored at the Sub-office and to condemn such as was found useless.

Assistant Morse was on duty at the Sub-office during November and December. He computed time and azimuth observations and made magnetic determinations at the Presidio, and computed micrometer observations for the variation of latitude work of Assistant Davidson.

Mr. Ferdinand Westdahl inked and traced a topographical sheet, made the annual inventory, and reduced the special hydrographic survey which he had made around part of Point Lobos.

Mr. Edmonds, besides attending to clerical work, observed solar time for the clock at the Sausalito Tide Station, and made special leveling observations.

OBITUARY NOTICE.

During the year the Survey suffered the loss, by death, of two of its oldest assistants in point of service. Assistant James S. Lawson entered the service in 1848, and was assigned to duty on the Pacific Coast in 1850, and for upwards of forty years he served actively in the field on all parts of that coast from San Diego to the Strait of San Juan de Fuca. He died on November 7, 1893, in San Francisco.

Assistant Spencer C. McCorkle also entered the service in 1848 and served actively in the field on all parts of the Atlantic and Gulf coasts. He died in Washington, March 20, 1894.

The record of the services of these two officers is contained in the annual reports of the survey, and is referred to in memorial notices issued by the Superintendent announcing their deaths. In these a suitable tribute is paid to the high characters of the deceased, which secured to them the esteem of all who knew them.

U. S. COAST AND GEODETIC SURVEY REPORT FOR 1894.

PART I.

FIELD AND OFFICE DETAILS.

TABULAR STATEMENTS AND ANNUAL OFFICE REPORTS.

TABLE NO. 1.

Distribution of the field parties of the Coast and Geodetic Survey upon the Atlantic, Gulf of Mexico, and Pacific coasts, and in the interior of the United States during the fiscal year ending June 30, 1894.

TABLE NO. 2.

Statistics of field and office work of the Coast and Geodetic Survey for the fiscal year 1894, and total to June 30, 1894.

TABLE NO. 3.

Information furnished to Departments of the Government in reply to special requests, and to individuals upon application, during the fiscal year ending June 30, 1894.

OFFICE REPORT NO. 1.

Report of the Assistant in charge of the Office for the fiscal year ending June 30, 1894.

OFFICE REPORT NO. 2.

Report of the Hydrographic Inspector for the fiscal year ending June 30, 1894.

OFFICE REPORT NO. 3.

Report of the Disbursing Agent for the fiscal year ending June 30, 1894.

OFFICE REPORT NO. 4.

Report of the Assistant in charge of State Surveys for the fiscal year 1894.

OFFICE REPORT NO. 5.

Report of the Assistant in charge of the Office of Standard Weights and Measures for the fiscal year ending June 30, 1894.

TABLE No. 1—1894.

Distribution of the Field Parties of the United States Coast and Geodetic Survey upon the Atlantic, Gulf of Mexico, and Pacific coasts, and in the interior of the United States, during the fiscal year ending June 30, 1894.

I.—EASTERN DIVISION—STATES EAST OF THE MISSISSIPPI RIVER.

States.	Parties.	Operations.	Persons conducting operations.	Localities of work.
Maine	No. 1	Hydrography	Stehman Forney, assistant	Completion of the hydrographic survey of the Northeastern Boundary Lakes.
Maine, Connecticut and New York.	2	Hydrography	Lieut. E. H. Tillman, U. S. N., assistant.	Hydrographic examinations on the northwest coast of the Gulf of Maine, and on the north shore of Long Island Sound.
Massachusetts	3	Topography	H. L. Whiting, assistant	Topographic resurvey of Boston bay and harbor.
Massachusetts	4	do	R. M. Bache, assistant	Do.
Massachusetts	5	do	C. T. Iardella, assistant	Do.
Massachusetts	6	do	H. G. Ogden, assistant	Do.
Massachusetts	7	do	O. H. Tittmann, assistant	Do.
Massachusetts	8	do	C. H. Boyd, assistant	Do.
Massachusetts	9	do	W. I. Vinal, assistant	Do.
Massachusetts	10	Hydrography	Lieut. W. F. Low, U. S. N., assistant.	Completion of the main portion of the hydrographic resurvey of Boston Harbor.
Massachusetts	11	Town boundary surveys and leveling of precision.	H. L. Whiting, Commissioner of State Topographical Survey; C. H. Van Orden, assistant.	State of Massachusetts.
Massachusetts	12	Relative gravity	G. R. Putnam, subassistant	Boston-Cambridge.
Massachusetts	13	Physical hydrography	H. L. Marindin, assistant	Survey of the north shore of Nantucket Island.
Rhode Island	14	Automatic tidal station	Officers of U. S. Engineers	Fort Adams, Newport Harbor.
Connecticut	15	Topography	J. W. Donn, assistant	Connecticut River.
Connecticut	16	do	C. H. Boyd, assistant	Do.
Connecticut	17	do	W. I. Vinal, assistant	Do.
New York	18	do	C. T. Iardella, assistant	Long Island, Bellport Bay to eastward.
New York		Relative gravity	G. R. Putnam, subassistant	Ithaca, N. Y. (See No. 12.)
New York	19	Topography	J. W. Donn, assistant	Hudson River.
New York to Virginia		Hydrographic examinations.	Lieut. E. H. Tillman, U. S. N., assistant.	From Coney Island, N. Y., to Cape Charles, Va.
New York	20	Automatic tidal station	Officers of the U. S. Engineers	Willets Point.
New York	21	do	J. G. Spaulding	Fort Hamilton, New York Harbor.
New Jersey and Penna.		Relative gravity	G. R. Putnam, subassistant	Princeton and Philadelphia.
New Jersey	22	Geodetic	Prof. E. A. Bowser, acting assistant; G. A. Fairfield, assistant in charge of State surveys.	Southeastern New Jersey.
Maryland	23	Base measurement	D. B. Wainwright, assistant	Baltimore.
Maryland and D. C.	24	Relative gravity	E. D. Preston, assistant	Baltimore-Washington.
District of Columbia	25	Experimental leveling	C. H. Van Orden, assistant	Washington, D. C.
District of Columbia	26	Automatic tidal station	Tidal division, Coast and Geodetic Survey Office.	Navy-Yard, Washington, D. C.
Virginia		Relative gravity	G. R. Putnam, subassistant	Charlottesville, Va.
North Carolina	27	Hydrographic examination	Lieut. L. M. Garrett, U. S. N., assistant.	Outer Diamond Shoal, N. C.
South Carolina	28	Topography	J. W. Donn, assistant	Cooper, Ashley, and Wando rivers, S. C.
South Carolina	29	do	C. H. Boyd, assistant	Do.
South Carolina	30	do	W. C. Hodgkins, assistant	Do.
South Carolina	31	Hydrography	Lieut. R. G. Peck, U. S. N., assistant	Do.
Georgia		Hydrography	Lieut. L. M. Garrett, U. S. N., assistant.	St. Simons Sound and Savannah River.
Florida	32	Geodetic leveling	Isaac Winston, assistant	St. Augustine to Cedar Keys.
Florida	33	Hydrography	Lieut. G. W. Mentz, U. S. N., assistant.	St. Lucie Inlet, Key West, and Tampa Bay. Pensacola Bay and approaches.
Florida	34	Hydrography	Lieut. F. Swift, U. S. N., assistant	Tributaries of Pensacola Bay.
Florida	35	Topography	P. A. Welker, assistant	Do.
Alabama	36	Reconnaissance	F. W. Perkins	Completion of reconnaissance in southern Alabama for extension of triangulation to the Gulf Coast.
Illinois	37	Gravity work	Defforges-Preston	Chicago.
Tennessee	38	Geodetic	Prof. A. H. Buchanan, acting assistant; George A. Fairfield, assistant in charge of State surveys.	Continuation of triangulation in northeastern Tennessee to connect with the triangulation along the Blue Ridge.

TABLE No. 1—Continued.

II.—MIDDLE DIVISION—STATES AND TERRITORIES BETWEEN THE MISSISSIPPI RIVER AND THE ROCKY MOUNTAINS.

States.	Parties.	Operations.	Persons conducting operations.	Localities of work.
Minnesota and Wisconsin	No. 39	Geodetic	Prof. W. R. Hoag, acting assistant; Geo. A. Fairfield, assistant in charge of State surveys.	States of Minnesota and Wisconsin.
Minnesota	40	Triangulation and topography.	W. C. Hodgkins, assistant; Prof. W. R. Hoag.	Minneapolis and St. Paul and vicinity.
Kansas	41	Triangulation	F. D. Granger, assistant	Kansas.
Kansas, Missouri, and Arkansas.	42	Geodetic leveling	Isaac Winston, assistant	Kansas, Missouri, and Arkansas.
Louisiana		Hydrography	Lieut. G. W. Mentz, U. S. N., assistant.	Search for shoal of South Pass, Mississippi River.
Texas and Mexico	43	Reconnaissance	Stehman Forney, assistant	The Rio Grande toward the Gulf. United States and Mexican boundary.
Texas	44	Magnetic observations	L. G. Schultz, observer; R. E. Halter, assistant.	Magnetic record continued at the self-registering station, Hillside Ranch, San Antonio, Texas.

III.—WESTERN DIVISION—STATES AND TERRITORIES BETWEEN THE ROCKY MOUNTAINS AND THE PACIFIC.

States or Territories.	Parties.	Operations.	Persons conducting operations.	Localities of work.
California	No. 45	Hydrographic examinations.	Lieut. F. H. Crosby, U. S. N., assistant.	San Diego and San Pedro.
California	46	Special examination	A. F. Rodgers, assistant	Position of wreck of steamer *Los Angeles*, southwest of Point Sur.
California	47	Hydrographic examination.	A. F. Rodgers, assistant; Ferdinand Westdahl.	Point Lobos, California.
California	48	Hydrography	Lieut. F. H. Crosby, U. S. N., assistant.	Inshore hydrography, San Francisco entrance and approaches.
California	49	Topography	A. F. Rodgers, assistant	Resurvey of shores of San Francisco Bay
California	50	Automatic tidal station	G. Davidson, assistant; Emmet Gray, tidal observer.	Sausalito.
California-Oregon	51	Telegraphic longitudes	G. Davidson, assistant; S. S. Gannett (Geological Survey).	San Francisco, Cal.; Eugene, Oreg.
Washington	52	Hydrography	Lieut. F. H. Crosby, U. S. N., assistant.	Coast of Washington, from James Island to Arch Rock.
Washington	53	Telegraphic longitude	G. Davidson, assistant; C. H. Sinclair, assistant.	Tacoma-Seattle.
Washington	54	Triangulation	J. J. Gilbert, assistant	Strait of San Juan de Fuca and Washington Sound.
Washington	55	Hydrography	Lieut. Lucian Flynne, U. S. N., assissant.	Strait of San Juan de Fuca
Utah and Colorado	56	Triangulation	Wm. Eimbeck, assistant	Utah and Colorado.
Colorado	57	Reconnaissance and triangulation.	F. W. Perkins, assistant	Colorado.
Utah and Colorado	58	Triangulation	P. A. Welker, assistant	Utah and Colorado.

TABLE No. 1—Continued.

IV.—THE DIVISION OF ALASKA, INCLUDING ITS COASTS BORDERING ON THE PACIFIC OCEAN, ON BERING SEA, AND ON THE ARCTIC OCEAN; ALSO ITS INLETS, SOUNDS, BAYS, RIVERS, AND THE ALEUTIAN AND PRIBILOF ISLANDS.

Territory.	Parties.	Operations.	Persons conducting operations.	Localities of work.
Southeastern Alaska	No. 59	Hydrographic and general surveys.	Lieut. Commander W. I. Moore, U. S. N., assistant.	Sitka Sound, Sitka Harbor, and approaches (1893), Chatham Strait, Tinakeo Passage, Pavlov Harbor, and Wachusett Cove (1894).
Southeastern Alaska	60	Transportation of Boundary Survey parties of the chronometers between astronomical stations, etc., sketches of topographical features for charts, etc.	Lieut. C. B. Harber, U. S. N., assistant.	Sitka and the astronomical stations of the Boundary parties.
Southeastern Alaska	61	Automatic tidal station	Fremont Morse, assistant; F De Groff, tidal observer.	Sitka.

The names of chiefs of parties engaged in the Alaska Boundary work, and the localities of their surveys will be found under the heading of "Special Operations."

SPECIAL OPERATIONS.

Parties.	Persons conducting operations.	Localities of work.
No. 62	The Superintendent; D. B. Wainwright, assistant	Boundary line in Passamaquoddy Bay, between the United States and the Dominion of Canada.
63	Edwin Smith, assistant	Rockville, Md. Variation of latitude.
64	James B. Baylor, assistant	Waters of the State of Virginia. Limiting lines of natural oyster beds.
65	Homer P. Ritter, expert observer	Mobile Bay and vicinity. Limiting lines of natural oyster beds for United States Commission of Fish and Fisheries.
66	A. T. Mosman, assistant, and United States Commissioner.	United States Commission to relocate and mark the United States and Mexican Boundary line from the Rio Grande to the Pacific.
67	Lieut. Commander W. I. Moore, U. S. N., assistant; Lieut. F. H. Crosby, U. S. N., assistant.	Cooperation with Navy Department in the speed trial of the new cruiser *Olympia*.
68	George Davidson, assistant; C. H. Sinclair, assistant; W. B. Fairfield, assistant.	Location and marking of the boundary line between California and Nevada from Lake Tahoe to the Colorado River.
69	George Davidson, assistant	San Francisco, Lafayette Park Station. Variation of latitude.

ALASKA-BRITISH COLUMBIA BOUNDARY.

70	E. F. Dickins, assistant	Unuk River, Alaska (1893–4); Chilkat Inlet, Alaska (1894).
71	O. H. Tittmann, assistant	Stikine River, Alaska, (1893).
72	Fremont Morse, assistant	Sitka astronomical station (1893-4).
73	Homer P. Ritter, expert observer	Holkham Bay–Endicott Arm (1893); Chilkat Inlet and River (1894); topographic reconnaissance to northward and westward.
74	Herbert G. Ogden, assistant	Taku and Stikine Rivers (1893).
75	J. E. McGrath, assistant	Taku Inlet and Stikine River (1893). South end of Malaspina Base to the delta of Yahtse River (1894).
76	J. F. Pratt, assistant	Chilkat and Taiya inlets. Triangulation, topographic reconnaissance, and astronomical station, west side Chilkat Inlet (1894).
77	J. A. Flemer, assistant	Taiya Inlet and River. Topographic reconnaissance to northward and eastward (1894).

HAWAIIAN ISLANDS.

	Hawaiian Government Survey	Honolulu, Hawaiian Islands. Tracings of automatic tide gauge and record.

TABLE No. 2—1894.

Statistics of field and office work of the Coast and Geodetic Survey for the fiscal year 1894, and total to June 30, 1894.

	Total to June 30, 1893.	During fiscal year 1894.	Total to June 30, 1894.
RECONNAISSANCE.			
Area in square statute miles	434 190	11 520	445 710
Parties, number of	3	....	....
BASE LINES.			
Primary, number of	16	....	16
Primary, length of, in statute miles	105	....	105
Subordinate, number of	157	2	159
Subordinate and beach measures, length of	576	2	578
TRIANGULATION.			
Area in square statute miles	295 280	11 030	306 310
Stations occupied for horizontal measures, number of	13 903	377	14 280
Geographical positions determined, number of	26 321	667	26 988
Stations occupied for vertical measures, number of	1 014	59	1 073
Elevations determined trigonometrically, number of	2 486	152	2 638
Heights of permanent bench marks by spirit leveling, number of	932	42	974
Lines of spirit leveling, length of, in statute miles	4 633	158	4 791
Triangulation and leveling parties, number of	....	16	....
ASTRONOMICAL WORK.			
Azimuth stations, number of	243	8	251
Latitude stations, number of	396	9	405
Longitude stations, telegraphic, number of	170	3	173
Longitude stations, chronometric or lunar, number of	118	1	119
Astronomical parties, number of	....	7	....
MAGNETIC WORK.			
Stations occupied, number of	926	69	995
Magnetic observatories occupied, number of	5	1*	5
Magnetic parties, number of	....	10	....
GRAVITY MEASURES.			
Home stations occupied, number of	27	3	30
Foreign stations occupied, number of	28	....	28
Parties, number of	....	2	....

* Old station.

TABLE No. 2—Continued.

	Total to June 30, 1893.	During fiscal year 1894.	Total to June 30, 1894.
TOPOGRAPHY.			
Area surveyed, in square statute miles	37 591	210*	37 801
Length of general coast, in statute miles	11 056	81	11 137
Length of shore line, in statute miles, including rivers, creeks, and ponds	98 929	416	99 345
Length of roads, in statute miles	48 746	554	49 300
Topographical parties, number of	....	22	....
HYDROGRAPHY.			
Parties, number of, in charge of naval officers	....	10	....
Parties, number of, in charge of civilian officers	....	2	....
Number of miles (geographical) run while sounding	491 263	6 941	498 204
Area sounded, in square geographical miles	158 464	1 220	159 684
Miles run additional of outside or deep-sea soundings	92 955	....	92 955
Number of soundings	21 039 391	344 497	21 383 888
Deep-sea soundings	13 270	....	13 270
Deep-sea temperature observations	17 955	....	17 955
Current stations, number of, occupied by hydrographic parties	....	70	....
Deep-sea current stations, number of	....	....	....
Deep-sea subcurrent observations, number of	....	....	....
Deep-sea surface current observations, number of	....	....	....
Specimens of bottom, number of	13 938	77	14 015
Automatic tide gauges established	104	1	105
Automatic tide gauges discontinued	99	....	99
Parties doing tidal work exclusively	....	4	....
Parties doing tidal work in connection with hydrographic work	....	12	....
Staff and box gauges established	2 262	47	2 309
Staff and box gauges discontinued	2 262	43	2 305
RECORDS.			
Tidal and current observations, originals, number of vols.	5 037	73	5 110
Tidal and current observations, duplicates, number of vols.	3 337	60	3 397
Aggregate years of record for automatic tide gauges	294	17	311
Tidal stations for which reductions have been made	1 623	32	1 655
Aggregate years of record reduced	317	11	328
Triangulation, originals, number of volumes	6 471	189	6 660
Triangulation, originals, number of cahiers	....	17	....
Astronomical observations, originals, number of volumes	2 145	61	2 206
Astronomical observations, originals, number of cahiers	....	4	....
Magnetic observations, originals, number of volumes	691	6	697
Magnetic observations, originals, number of cahiers	....	65	....
Pendulum observations, originals, number of volumes	....	12	....
Duplicates of above, number of volumes	7 096	250	7 346
Duplicates of above, number of cahiers	....	54	....
Geodetic leveling observations, number of vols., originals	....	48	....
Geodetic leveling observations, number of vols., duplicates	....	27	....
Computations, number of volumes	4 378	4	4 382

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* Not including topographical reconnaissance and special examinations in Alaska, which extended over an approximate area of 3,257 square miles.

TABLE No. 2—Continued.

	Total to June 30, 1893.	During fiscal year 1894.	Total to June 30, 1894.
Computations, number of cahiers	....	267	....
Hydrographic soundings and angles, originals, number of volumes	12 506	241	12 747
Hydrographic soundings and angles, duplicates, number of volumes	4 100	194	4 294
MAPS AND CHARTS.			
Topographic maps, originals	2 125	44	2 169
Hydrographic charts, originals	2 362	30	2 392
ENGRAVING.			
Engraved plates ot charts	523	31	554
Engraved plates of preliminary charts and diagrams for the Coast and Geodetic Survey reports, and of maps of the District of Columbia	803	51	854
Engraved plates of Coast Pilot charts	80	....	80
Engraved plates of Coast Pilot views	104	....	104
Electrotype plates made	2 333	92	2 425
PRINTING.			
Sheets of charts and maps deposited with sale agents	456 798	23 540	480 338
Sheets of charts and maps sold at Coast and Geodetic Survey Office	....	437	....
Sheets of charts and maps distributed to Congress, Executive Departments, Foreign Governments, libraries, etc	....	27 694	....
Sheets of charts and maps, total distribution	943 278	51 671	994 949

TABLE No. 3—1894.

Information furnished to Departments of the Government in reply to special requests, and to individuals upon application during the fiscal year ending June 30, 1894.

Date.	Name.	Data furnished.
1893.		
July 1	U. S. Geological Survey	Geographical position furnished.
1	U. S. Naval Observatory	Geographical positions and descriptions of triangulation stations.
7	E. B. Thomson, St. Augustine, Fla	Positions and descriptions of trigonometrical stations.
8	Thomas H. Hastings, Hastings, Fla	Height and description of bench marks.
11	M. McLaughlin	Distance from World's Fair grounds to Fontanet, Ind.
13	W. C. Holbrook, Sterling, Ill	Elevation of bench mark at Fulton, Ill., above the Gulf of Mexico.
15	G. B. Magraghi, Commando della division navale in America.	Geographical position of three lighthouses, with their distances and azimuths.
15	E. W. Van C. Lucas, Lieutenant U. S. Engineers, Wilmington, N. C.	Publications of the Survey relating to tides and currents.
17	H. D. Whitcomb, Richmond, Va	Method of tide reduction.
17	W. W. Austin, Winchester, Ky	Geographical position of Winchester, Clark County Ky.
17	E. T. Burns, Niagara Falls, N. Y	Geographical position, geodetic data, and description of stations near Niagara Falls.
18	W. R. Livermore, Major Engineers, U. S. Army	Change in the magnetic declination at Hendricks Head Light since 1829, and at Moskegan Light since 1823.
20	S. M. Holdrege, San Francisco	Geodetic data of thirty-nine trigonometrical stations near Point Arena, Cal.
22	A. M. Ford, Salem, N. J	Storm tides at Sandy Hook, N. J.
22	Peter C. Haines, Lieut. Col., U. S. Engineers	Tides in Kennebec River, Me.
25	C. P. Goodyear, Brunswick, Ga	Plotting of hydrography of St. Simons Bar, Ga. Scale 1-1 200.
27	Edward H. Hawes, Boston, Mass	Tracing of Waquoit Bay, Mass.
Aug. 7	F. B. Tobey, Dennis, Mass	Tracing of topography of the town of Dennis, Mass.
7	G. S. Green, jr., Department of Docks, N. Y. City, N. Y	Plotting of railroads on chart No. 122.
14	H. D. Whitcomb, Richmond, Va	Forms for first reduction of tides.
15	G. S. Webster, Philadelphia	Horizontal directions at seven stations near Philadelphia, Pa.
22	R. Davis, Philadelphia	Information respecting calculating machines.
22	Chas. W. Friend, Carson, Nev	Astronomical positions in Carson City, Nev.
22	C. S. Woodward, Ypsilanti, Mich	Magnetic declination on Mackinac Island in 1811.
24	J. A. Timmons, St. Mary, Ky	Results of an investigation of the boundaries of Yellowstone Park reservation.
24	Milton Updegraff, Columbia, Mo	Description of astronomical stations of the Coast and Geodetic Survey in St. Louis since 1869.
25	T. D. Leffingwell, Abingdon, Va	Magnetic declination between the years 1790 and 1900 for southwestern Virginia.
25	F. W. Beers, New York, N. Y	Tracing of part of Hempstead Harbor, L. I.
28	Adams Express Co., Baltimore	Distances from Baltimore to various points on the eastern shore of Maryland.
28	W. M. Black, Captain, U. S. Engineers	Geodetic data and spirit levels near Willets Point, N. Y.
31	W. M. Black, Captain, U. S. Engineers	Sketch of triangulation.
Sept. 1	V. G. Barbour, Burlington, Vt	Geographical positions and geodetic data for the survey of the west boundary between Massachusetts and Vermont.
2	T. B. Brooks, Newburg, N. Y	Tracing of topography, Hudson River.
4	E. T. Witherby, Shelby, Ala	Height of Weogufka Station.
4	H. T. Gunnison, Brooklyn, N. Y	Tidal data.
5	J. E. Savage	Copy of topographic sheet No. 1243.
7	Z. T. Gilpin, Oakland, Cal	Tracing of topography and hydrography near Oakland, Cal.
7	J. A. Timmons, St. Mary, Ky	Length of statute miles in metres.
8	F. D. Leffingwell, Montclair, N. J	Secular variation of magnetic declination, latitude 40° 50′ and longitude 74° 12′.
8	Mr. Bodfish, Washington	Difference of heights of bench marks near Great Falls and at the Capitol.
15	P. Brooks, Sidney	Remarks on plane and spherical coordinates and on heliotropes.
16	Chas. E. L. B. Davis, Major U. S. Engineers, Washington D. C.	Description of bench mark, West Point, York River, Va.
19	H. M. Carpenter, Avondale, Pa	Magnetic declination at Avondale in 1890 and 1893.
21	Florida Coast Line Canal and Transportation Company	Description of three bench marks, Lake Worth and Hillsboro Inlet, Fla.
28	Morrow Bay Improvement Company	Description of bench mark, Morrow Bay, Cal.

TABLE No. 3—Continued.

Date.		Name.	Data furnished.
1893.			
Oct.	2	J. S. Wall, Harrisburg, Pa	Data relating to boundary line and list of astronomical and geographical positions.
	3	E. A. Kemmler, Ohio State University	Magnetic declinations at Columbus, Ohio, in July, 1891.
	3	Chief of Bureau of Ordnance, U. S. Navy	Geographical positions and trigonometric stations on the Potomac.
	5	Chief of U. S. Weather Bureau	Magnetic declinations at one hundred and fifty-seven Weather Bureau stations.
	7	Chief of Bureau of Ordnance, U. S. Navy	Tracing of topography.
	9	United States and Mexican Boundary Commission	Telegraphic longitudes of Yuma, Nogales, El Paso, and Upper Corner B.
	10	E. R. Davenport, Gallipolis, Ohio	Early magnetic observations at Gallipolis and present annual change.
	10	Edwin R. Sherwood, Philadelphia	Tracing from topographic sheet 1502*a*.
	11	Navy Department	Tracing of speed trial course on Pacific Coast.
	11	M. Updegraff, Columbia, Mo	Height of St Louis bench mark above Biloxi, Miss.
	17	W. A. Hedrick, Washington, D. C	Magnetic, horizontal, and total intensity in the District of Columbia for 1888 and 1893.
	17	Sam'l J. Saunders, Clinton, N. J	Magnetic horizontal force at Clinton, N. J., in 1885.
	18	H. O. Hoskold, Buenos Ayres	Information about base lines.
	20	J. B. Rawls, Deer Park, Ala.	Height of bench mark on M. & O. R. R.
	21	Hon. Thomas F. Magner, Brooklyn, N. Y	Copy of topography about Hempstead Bay, N. Y.
	24	B. F. Haynes, Marion Station, Md	Magnetic declination near Cape Henry in December, 1853, and October, 1893, and present bearing of line run at former date.
	24	H. C. Ripley, Civil Engineer, Galveston, Tex	Tracing of topography of part of Galveston Island, Tex.
	26	T. B. Brooks, Newburg, N. Y	Geographical position near Storm King, N. Y.
	26	W. B. Clark, Baltimore	Tracing of topography near Fort Washington, Potomac River.
	26	Lieut. Col. H. M. Roberts, U. S. Engineers	Tracing of topography and hydrography of Greenport Harbor, Long Island.
	27	Alex. Agassiz, Cambridge, Mass	Bottom specimens plotted on charts.
	30	J. E. Savage & Co., Bar Harbor, Me	Copies of 6 topographic sheets of Mount Desert.
	30	C. W. Ernst, Boston, Mass	Data relating to first published charts of Boston Harbor.
	30	W. R. Livermore, Major U. S. Engineers	Description of bench mark, Fort Point, Penobscot River, Me.
	30	Lieut. M. M. Macomb, U. S. Army	Three specimens of least square adjustment of triangulation.
	30	S. J. Saunders, Clinton, N. J	Reference to magnetic records, results and discussions of sun spots during 1860–1870.
Nov.	1	G. & C. Merriam & Co., Springfield, Mass	Boundaries of Yellowstone Park.
	3	A. B. Sutton, Richmond, Va	Variation of magnetic declination Caroline County, since 1780, and change in the ninety last years.
	4	H. A. Howe, Denver, Colo	Height of Denver railroad depot above the ocean.
	4	South Carolina Fish Commission	Projections and shore line of locality covered by original sheets 803, 840, and 1196.
	6	R. A. Daly	Approximate height of Mount Ascutney, Vt.
	7	W. J. King, International Boundary Commission	Geographical position of three astronomical stations in southeastern Alaska.
	7	Wm. M. Thomas, Charleston, S. C	Description of bench marks, Charleston, S. C.
	7	B. E. Valentine, Brooklyn, N. Y	Two copies from original topographic sheets of Hempstead Bay.
	13	H. A. Brown, Surveyor, Newbern, N. C	Table of magnetic declination at Newbern, computed for the years 1770 to 1900, with notes.
	13	C. C. Fitts, Brattleboro, Vt	Change in magnetic bearings of a line run at Brattleboro in 1817 and 1893–8.
	15	J. S. McAdams, Shamokin, Pa	Triangulation data for surveys in Columbia and Northumberland counties, Pa.
	15	F. N. Wales, Boston, Mass	Tracing of surveys of East Bay, Mass.
	16	E. L. Schafner, Tacoma, Wash	Copies of surveys from the head of Cases Inlet and Hoods Canal, Wash.
	17	J. P. Bogart, New Haven, Conn	Geographical positions of two trigonometrical stations in Southport, L. I.
	21	W. R. Hillyer, Civil Engineer, Port Richmond, L. I	Geodetic positions and descriptions of stations.
	21	U. S. Engineers	Copies of surveys in Cape Fear River and about Key West.
	22	H. W. Bently, Boonville, N. Y	Present magnetic bearing of two old lines, and secular variation of the magnetic declination between 1790–1895 in the vicinity of Oneida, N. Y.
	22	R. L. Williams, Sparta, Va	Change of magnetic declination in Caroline County, since the last 90 years.
	23.	E. P. Alexander, Georgetown, D. C	Effect of wind upon the tide.
	28	Wm. Ellinger, Baltimore, Md	Tracings of surveys, Tangier Sound.
Dec.	1	G. H. Saddleson	Annual change of the magnetic declination in Moore County, N. C.
	2	Hermann Trott, South Bend, Wash	Storm tides of the Pacific Coast.
	4	General Land Office	Tracings from original surveys of Steamboat and Hope Islands and vicinity, Puget Sound, Wash.
	5	Ed. H. McLachlin, South Hadley Falls, Mass	Formula and numerical constants.
	5	Calhoun & Sherwood, Coupeville, Wash	Highest tide at Coupeville, Wash.
	6	E. A. Bowser, Rutgers College, N. J	Secular variation of the magnetic declination at Cold Spring Harbor, L. I., and Bethlehem, Pa.
	7	T. H. R. Johnson, Fort Smith, Ark	Height of bench mark.

TABLE No. 3—Continued.

Date.	Name.	Data furnished.
1893.		
Dec. 9	R. Grimshaw, Civil Engineer, New York, N. Y	Reference to barometric formulæ and tables.
13	A. M. Ford, Salem, N. J	Storm tides at Fort Hamilton.
14	E. A. Bowser, Rutgers College, N. J	Magnetic declination, etc.
16	G. H. Clark, Brattleboro, Vt	Magnetic declination, 1800–1895, for Chesterfield and Williamstown.
18	J. B. Tolley, Boston, Mass	Triangulation data.
22	Gen. Floyd King, Brunswick, Ga	Depths on St. Simons Bar.
22	W. H. Pearson, Vassalboro, Me	Height of Mount Sebattis, Me.
22	D. W. Lockwood, U. S. Engineers	Table of variation of magnetic declination in Kentucky, 1820–1895.
27	Edw. C. Roberts, Saltville, Va	Change of magnetic variation, 1790–1895, Washington County, Va.
27	Director Geological Survey	Azimuth of a survey line in Tennessee.
27	T. F. Magner, Brooklyn, N. Y	Copy of topographic survey opposite Woodsburg, Long Island.
27	Lieut. A. M. D'Armit, U. S. Engineers	Copy of survey of Indian River Inlet.
28	E. A. Bowser, Rutgers College, N. J	Change of bearing of the line in New Jersey, between 1749 and 1894.
28	Thomas Kiernan, Civil Engineer, Fall River, Mass	Description of bench mark, Bristol Ferry, R. I.
29	Cramp & Sons, Philadelphia, Pa	Position of Five Fathom Bank light-ship.
1894.		
Jan. 2	C. D. Sigsbee, Commander U. S. Navy	Data for tidal prediction at Eastport, Me.
3	Thomas Kieran, Fall River, Mass	Description of bench mark, Fall River, Mass.
3	C. S. Mott, Patchogue, Long Island, N. Y	Computation of line, Penfield Reef lighthouse to Southport, etc.
3	Lieut. E. E. Winslow, U. S. Engineers, Mobile, Ala	Description of bench marks and of astronomical station.
4	Col. J. M. Wilson, U. S. Engineers	Tracing of original topographic sheet 1467 and hydrography.
6	Lieut. A. Marix, U. S. Navy, New York, N. Y	Tidal observations at Nortons Point.
6	C. P. Goodyear, Brunswick, Ga	Tidal data for St. Simon's light, Ga.
6	Topographer, U. S. Post-Office	Geographical positions on the Ohio River.
6	A. T. Byrne, Brooklyn, N. Y	Geographical positions at Jamaica Bay, and description of stations.
11	H. L. Pritchett, St. Louis, Mo	Geographical position of Washington University Observatory, St. Louis, Mo.
12	W. C. Riddick, Collector of Agricultural and Mechanical Arts, North Carolina.	Table of magnetic change of declination, 1790 and 1900, in central North Carolina, and change from 1855–1892 at Raleigh.
13	C. S. Woodward, Ypsilanti, Mich	Method of observing solar spots.
16	Maj. Chas. E. L. B. Davis, U. S. Engineers	Description of bench mark at Old Point Comfort, Va.
17	M. Updegraff, Columbia, Mo	Information respecting the longitude station at St. Louis.
19	J. C. O'Conner, New York, N. Y	Tracing of topography of part of Back Bay, Va.
22	Director Geological Survey	Geographical position of Mount Treasury, and azimuth to Mount Waas.
23	C. S. Randall, New Bedford, Mass	Map of southeastern Massachusetts, Cape Cod, and Vineyard Sound.
25	Ford & Beach, Brooklyn, N. Y	Copy of hydrography of Gravesend Bay.
25	A. J. Bangs, Washington, D. C	Difference of average levels of the Potomac at Washington, D. C., and of the ocean at Cape Charles, Va.
31	Director Geological Survey	Geographical position of Uncompaghre, Colo.
Feb. 3	C. N. Kendall, Chicago, Ill	Data concerning the Great Lakes.
3	W. E. Sampson, Washington, D. C	Great circle distance from San Francisco to Honolulu and Yokohama.
7	Samuel Barnett, Washington, D. C	Concerning refined length measures.
9	Capt. W. H. Bixby, U. S. Engineers	Description of bench marks in Massachusetts and Rhode Island.
19	J. P. Bogart, Civil Engineer, New Haven, Conn	Estimate for making computations.
19	Prof. W. H. Brewer, New Haven, Conn	Diurnal irregularity of tides, etc.
23	W. C. Irwin, Cleveland, Ohio	Information respecting magnetic poles and lines of equal magnetic declination.
26	V. D. Groner, Norfolk, Va	Description of three bench marks.
27	F. T. Hills, Atlantic City, N. J	Method of computing distance and azimuth between known points.
Mar. 1	W. Bell Dawson, Ottawa, Canada	Information relating to tide predictions for Sandy Hook.
3	V. G. Barbour, Burlington, Vt	Geodetic data.
5	B. O. Peirce, Cambridge, Mass	Remarks on the presence or absence of an 18⅔ period in the earth's magnetic force.
7	Col. G. H. Elliott, U. S. Engineers	Remarks on the meridian of Washington.
8	C. P. Darling, Civil Engineer, Huntington, N. Y	Geodetical data.
8	Capt. F. V. Abbott, U. S. Engineers, Charleston, S. C	Geographical positions in Charleston Harbor.
9	F. L. Hoffman, Hampton, Va	Diurnal phenomena at various points.
10	U. S. Hydrographic Office	Geographical positions in Strait Juan de Fuca, and sketch of triangulation.
12	G. D. Howell, Chester, Pa	Description of bench marks.
12	R. W. Harris, West Point Pleasant, N. J	Geographical positions and description of stations near Monasquan River.
13	Cambridgeport Dairy Company, Cambridgeport, Mass	Predicted tides for various points.
16	L. M. Haupt, Philadelphia, Pa	Tracing of entrance and vicinity of Aransas Pass, Tex.
19	Bureau of Education	Drawings of maps for photolithographing.

TABLE No. 3—Continued.

Date.	Name.	Data furnished.
1894.		
Mar. 20	International Boundary Commission	Magnetic declination at Nogales, Yuma, and San Diego.
20	Isham Randolph, Chicago, Ill	Height above ocean of Lake Champlain and bench marks.
20	H. D. Whitcomb, Richmond, Va	Tide-gauge clocks.
21	U. S. Weather Bureau	Geographical position of 1,000 points determined by the Coast and Geodetic Survey.
22	Director U. S. Geological Survey	Positions and descriptions of fifty-four trigonometrical stations.
23	John Stewart, War Department	Magnetic declination of Wakefield, Va., in 1894.
26	F. D. Leffingwell	Copy of manuscript table of magnetic declinations.
27	William Guerin, New York	Tidal literature.
28	Colonel Mendell, U. S. Engineers	Tracing of survey of Point Loma, Cal.
29	E. M. Kemmler, Ohio State University	Expression for the magnetic declination and its annual change at Columbus, Ohio.
29	W. H. Bailey, Red Bank, N. J	Information respecting the hypsometric map of the United States.
29	Thomas F. Bowes, West Newton, Mass	Apparent declination of polaris.
29	G. Story, Civil Engineer, San Luis Obispo, Cal	Information relating to magnetic results.
30	U. S. District Attorney, Washington, D. C	Tracing of the Carollton Map.
April 2	G. L. Van Bibber, Belair, Md	Tracing of topography of Swan Creek and vicinity.
3	Thomas Monroe, Coteau Landing, P. Q	Information relating to levels about Lake Champlain.
4	G. L. Van Bibber, Belair, Md	Magnetic data for 1660, 1750, 1770, and 1894, and epoch of extreme east elongation.
4	J. F. Ambrose, Brooklyn, N. Y	Currents in New York Harbor.
5	F. W. Proctor, Highlands, Macon County, N. C	Diurnal inequality of tides.
6	E. P. Alexander, Georgetown, S. C	Storm tides near New York.
6	Cambridgeport Dairy Co., Cambridgeport, Mass	Predicted tides, Sitka, Alaska.
9	Colonel Mendell, U. S. Engineers	Copy of topographic survey.
9	Joseph Rowe, Priceville, Ky	Change of magnetic declination in Hart County, between 1795 and 1894.
12	Hydrographic Office	Data of the survey of 1871, Magdalena Bay ; geographical positions of lighthouses.
12	W. B. Edwards, Penick, Ky	Magnetic declination at Danville, Ky., and change during last fifty years.
14	Central School Supply Co., Chicago, Ill	Geographical positions and heights of mountains.
16	U. S. Geological Survey	Two hundred and fifteen geographical positions and descriptions of stations.
17	L. M. Haupt, Philadelphia, Pa	Tracing of the mouth of San Gabriel River, Cal.
18	C. E. Buck, Boston, Mass	Tracing of hydrography of Sheepscote River, Me.
19	Otis Ashmore, Savannah, Ga	Geographical positions of one hundred and eight principal cities of the United States.
21	U. S. Geological Survey	Geographical positions and description of stations in New York and Vermont.
23	J. Milne	Length of thirty-ninth parallel across the United States.
28	J. B. Baylor, Richmond, Va	Copy of boundary line between Maryland and Virginia.
30	J. G. Warren, U. S. Engineers	Geographical positions on Lake Pontchartrain and Lake Borgne, La.
30	Mississippi River Commission	Copy of hydrography and topography of Mississippi River, vicinity of New Orleans.
May 2	Wm. P. Craighill, Colonel U. S. Engineers	Mean low water, West Point, York River.
2	Queen & Co., Philadelphia, Pa	Magnetic data.
3	Chief of Engineeers. U. S. Army	Copy of topography of Point Loma, Chincook Point, Cape Disappointment.
8	Major Raymond, U. S. Engineers	Copy of surveys of part of Delaware Bay.
9	J. J. Warren, U. S. Engineers	Data relating to triangulation, mouth of Mississippi River.
14	F. Niernsee and A. G. Lamotte, Columbia, S. C	Latitude and longitude of the astronomical station of 1853, at Columbia, S. C.
14	G. L. Vose, Paris, Me	Agreement of base lines.
15	U. S. Geological Survey	Geographical positions and description of stations near Minneapolis, Minn.
15	E. W. Harrison, Philadelphia, Pa	Tidal data for Gloucester, N. J.
18	E. S. Starr, Philadelphia, Pa	Geographical positions in New Jersey, Pennsylvania, Maryland, and District of Columbia.
19	Colonel Mendell, U. S. Engineers	Copy of topography of Point. Loma.
19	L. M. Haupt, Philadelphia, Pa	Copy of Hydrographic Survey, 1894, of St. Simons Entrance.
25	E. B. Thompson, St. Augustine, Fla	Geographical positions, etc., of three lighthouses near Key West.
28	U. S. Fish Commissioner	Description of bench mark.
29	Maj. A. M. Damrell, U. S. Engineers	Copy of hydrography of Mobile Bay and entrance.
31	U. S. Geological Survey	Geographical positions and descriptions of stations in Pennsylvania, New Jersey, and Delaware.
31	C. Fernald, Assistant Engineer, District of Columbia	Height and description of two bench marks in District of Columbia.
31	U. S. Fish Commissioner	Hydrographic projections of St. Croix River.
June 1	Gall & Lembke, New York, N. Y	Geographical positions in New Canaan, Conn.

TABLE No. 3—Continued.

Date.	Name.	Data furnished.
1894.		
June 1	W. R. Yorks, Lima, N. Y	Secular change of magnetic declination at Lima, N. Y., 1820–1894, and present bearing of a line run in 1840.
5	P. McNeille, Southern Pines, N. C	Magnetic data.
5	E. S. Starr, Philadelphia, Pa	Geographical position of Easly, S. C.
7	F. H. Loud, Colorado Springs, Colo	Geographical position of seventeen triangulation stations.
9	Bradley & Pastes, New York, N. Y	Height of the Great Lakes above the ocean.
13	W. A. Garthright, Dabneys, Louisa County, Va	Tidal data, Fort Pulaski and Savannah, Ga.
16	Post Office Department	Geographical positions in North and South Carolina.
16	J. G. Kerry, East Liverpool, Ohio	Magnetic data.
19	Eugene Anderson, Civil Engineer, Dububue, Iowa	Geographical positions, vicinity of Dubuque, Iowa.
19	F. P. Gulliver	Trigonometric position and elevation of Mount Ascutney, Vt.
21	J. H. Gray, Pewee Valley, Ky	Height of Louisville, Ky.
22	W. W. Austin, Winchester, Ky	Geographical position of Escondido, Cal., and magnetic declination.
23	W. S. Krebs, Albert Lea, Minn	Position of the earth's magnetic poles at different epochs.
27	P. C. Kennedy, Engineer Sewerage Commission, Baltimore, Md.	Tracings of topographic sheets 401–436.
27	F. M. Eppley, New York, N. Y	Tracing of topography and hydrography, vicinity of North Brothers Island and Port Morris, East River, N. Y.
30	U. S. Geological Survey	Geographical position and description of trigonometrical positions in Vermont.
30	F. M. Wales, Engineer Harbor Commission, Boston, Mass	Tracings of hydrography of Boston Inner Harbor.

OFFICE REPORT No. 1—1894.

REPORT OF THE ASSISTANT IN CHARGE OF THE OFFICE FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

UNITED STATES COAST AND GEODETIC SURVEY,
Washington, D. C., October 24, 1894.

SIR: I have the honor to submit the annual report of the Office for the fiscal year ending June 30, 1894, and with it the annual reports of the various divisions thereof, as follows:

1. The Computing Division, Assistant C. A. Schott, Chief.
2. The Tidal Division, Mr. L. P. Shidy, Acting Chief.
3. The Drawing Division, Assistant Wm. H. Dennis, Chief.
4. The Engraving Division, Assistant Geo. A. Fairfield, Chief.
5. The Chart Division, Assistant Gershom Bradford, Chief.
6. The Miscellaneous Division, Mr. M. W. Wines, Chief.
7. The Instrument Division, Assistant E. Smith, Chief.
8. The Library and Archives Division, Mr. F. H. Parsons, Chief.

The details of the work in the several divisions will be found in the reports of their respective chiefs.

Beginning July 1, 1893, I was for the whole of the summer and part of the fall and at various other times during the year acting superintendent of the Survey, while the Superintendent, Dr. Mendenhall, was absent performing his duties as Boundary Commissioner or attending to duties that had been assigned him in connection with the World's Columbian Exposition.

Assistant Spencer C. McCorkle was relieved from duty with the assistant in charge of the office in July, 1894, and placed in charge of the Engraving Division, which had been left without a head upon the death of Assistant J. Henry Turner. He performed the duties with his usual zeal, and the Division was in its usual good working order when turned over by Assistant McCorkle to Assistant Ogden on October 9, 1893. He then returned to duty with me and was actively employed in advancing our chart work until early in March, when he was taken to Garfield Hospital where he died March 20, 1894, respected by all who knew him and beloved by his associates on the Coast and Geodetic Survey, in which work he had spent his life.

In the death of Mr. John G. Thompson, engraver, which occurred Friday, September 22, 1893, the service has lost a most worthy man, skilled in his work, consciencious in the discharge of every duty, and earnest in his efforts to advance the best interests of the public service. He will long be remembered by his late associates.

Mr. Robert T. Bassett, skilled laborer, also an old and trusted employee, died February 8, 1894.

Mr. C. E. Yarboro, messenger, was in the service only a few months when he died April 26, 1894.

Mr. A. B. Simons has attended to the duties of clerk to the assistant in charge of the office, Mr. E. B. Wills has attended to the "leave of absence" account, the freight and receipt books, etc., and Miss Ida Peck, Miss Sophie Hein, and Miss Kate Lawn have attended to the general typewriting of the office and to various clerical matters in a satisfactory manner.

Work in the several divisions of the office has proceeded in the usual manner. Assistant H. G. Ogden was again detached from the Engraving Division for duty in the field on June

7, 1894, and was succeeded by Assistant Geo. A. Fairfield, who was relieved from the temporary charge of the Tidal Division for that purpose. Mr. L. P. Shidy, computer, succeeded Assistant Fairfield in charge of the Tidal Division.

Respectfully, yours, B. A. COLONNA,
Assistant in charge of the Office.

GEN. W. W. DUFFIELD,
Superintendent, U. S. Coast and Geodetic Survey.

REPORT OF THE COMPUTING DIVISION, U. S. COAST AND GEODETIC SURVEY OFFICE, FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

COMPUTING DIVISION, *July 12, 1894.*

SIR: In conformity with the regulations of the Survey, I have the honor to submit herewith the usual annual report of the work done in the Computing Division of the office during the fiscal year ending June 30, 1894.

No change took place in the personnel of this Division during the year, and its charge was continued with the undersigned. But very little temporary aid was had, viz: A. S. Christie was connected with the Division but twenty-six days (in July); H. L. Stidham reported for duty November 16, 1893, and remained until February 27, 1894; John F. Hayford was assigned to the Division during one month and nineteen days (March 1 to April 19), and Sub-Assistant J. Nelson during fifteen days (May 11 to May 26, 1894).

The duties devolving upon me as Chief of the Computing Division consist mainly in directing and supervising the computations and reporting the results, and in preparing answers to scientific or professional inquiries in connection with official correspondence; in furnishing data or other information required for the use of field parties, or needed by the office, and in making such special investigations and examinations as may be assigned or called for.

Much of my time was consumed in making the discussion of the variability of the astronomic latitude of a place as shown from the extensive series of observations made at San Francisco, California, between May, 1891, and August, 1892, and comprising not less than 6,768 individual observations; my report of these results was submitted June 27, 1894.

Between July 24 and August 16, 1893, I had charge of the Coast and Geodetic Survey exhibit at the World's Fair at Chicago.

With respect to the part which I took in the Geodetic Conference, convened by the Superintendent of this office, and which remained in session from January 9 to February 28, 1894, I beg leave to refer to the report made by the chairman of the conference.

The discussion of the magnetic observations was kept up to date. I computed the latitude and the azimuth observed at Yakutat Bay, 1892. Among the reports made the following may deserve special mention: On the results of the difference of chronometric longitudes between Tacoma and Sitka and between Sitka and Yakutat, 1892; on the difference of longitude between Sitka and Taku, Fort Wrangell and Burroughs Bay, Alaska, 1893.

The annual statistics of astronomic, magnetic, and gravitation observations were attended to.

A specification of the work performed by each computer during the fiscal year is herewith presented; it is made up from the daily and monthly reports:

Edward H. Courtenay adjusted the coast triangulation of California between Ross Mountain and Mendocino City and in the vicinity of Shelter Cove; computed the triangulations in the vicinity of Needles, California, 1893, and of Yakutat Bay, Alaska, 1892, and made fair progress with the computation of the triangulation connecting Lake Tahoe with the main work in connection with the Boundary Survey, California and Nevada, 1893. Mr. Courtenay also attended to the arrangement for the binding of the geodetic, astronomic, and magnetic records in the archives; prepared geodetic or other data for use by the field parties, and directed part of the work of Mr. Boutelle, Mr. Kummell, and of Mr. Hurley. He also assisted in the preparation of the annual geodetic statistics of the Survey, and attended to miscellaneous computations, and had charge of the Computing Division during my absence in Chicago.

Myrick H. Doolittle computed the heights of the secondary triangulation stations on the coast of California, between Ross Mountain and King Peak; adjusted the position and result for height of Station Mount Conness, California; computed and adjusted the main triangulation in Kansas of 1890–'91–'92; adjusted the base figure for the introduction of St. Alban's Base, West Virginia, 1891–'92; made the least square abstracts of primary horizontal directions at stations Nebo, Utah, 1887; at Desert, Utah, 1887 and 1892; at Ogden, Utah, 1888 and 1891; at Pilot Peak, Nevada, 1889 and 1892, and at Ibepah, Utah, 1889. Mr. Doolittle nearly completed the adjustment of that part of the primary triangulation of Nevada and Utah lying between the line White Pine–Diamond Peak, and the lines Tushar, Nebo, and Ogden, Utah. He also assisted in the preparation of the geodetic annual statistics.

Henry Farquar supplied the mean places of a number of stars in addition to those furnished last year for the latitude computation of San Francisco, 1891–'92, and computed and discussed the observations for value of micrometer of zenith telescope No. 3, employed in the latitude work at San Francisco. Mr. Farquar also computed the following latitudes: Station of 35° past Colorado River, California and Nevada boundary, 1893; station on Burroughs Bay, Alaska, 1893; station on Taku River, Alaska, 1893; station at Fort Wrangell, Alaska, 1893; station at Sitka, Alaska, 1892; station at San Diego, California, 1892; station at Lake Tahoe, California, 1893, and of Station Nogales, Arizona, 1892.

Charles H. Kummell was chiefly engaged in the solution of normal equations demanded in the adjustment of secondary triangulations; in revising abstracts of horizontal directions at primary stations in Utah and Nevada, and in miscellaneous geodetic computations, assisting Mr. Courtenay in the computation of the triangulation of Yakutat Bay, Alaska, 1892. Mr. Kummell also computed coordinates for a zenithal projection for the United States (excepting Alaska), and extended the geodetic factors for the computation of geographical positions to higher latitude, so as to take in the whole of the Territory of Alaska.

John B. Boutelle was principally engaged in preparing or revising abstracts of angles or directions, and in computations of triangle sides and geographical positions. He plotted the triangulation of Massachusetts and prepared the manuscript copy of results for publication; computed the supplementary triangulation about San Francisco Bay of 1887–'92, and made good progress with the computation of the triangulation of Suisun Bay, 1886–'87–'88. Mr. Boutelle also attended to copying reports, and to miscellaneous matter connected with the work of the Division, in particular to furnishing copies of descriptions of stations.

Daniel L. Hazard made the computations for telegraphic differences of longitude of the following places: San Francisco and Sacramento, 1888–'89; San Francisco and Point Arena, 1889; Sacramento and Verdi, 1889; Verdi and Carson, 1889; Carson and Genoa, 1889; Carson and Lake Tahoe, 1893; Carson and Austin, 1889; Austin and Eureka, 1889; Eureka and Salt Lake, 1889; Marysville and Sacramento, 1889; Sacramento and Los Angeles, 1889; Los Angeles and San Francisco, 1889, and Los Angeles and Needles, 1889. He also computed the chronometric difference of longitude between Sitka and Yakutat, 1892, and between Sitka and the following places: Taku, Wrangell, and Burroughs Bay, all in Alaska, 1893. Mr. Hazard also computed the following azimuths: At Nevada and California boundary station of 1893 in latitude 35°; at Lake Tahoe southeast station, 1894; at Taku, 1893; at Fort Wrangell, 1893; and at Cabin, Stikine River, 1893. He also computed the triangulations of Commencement Bay, Washington, 1886 and 1892, and of Cooper and Wando rivers, South Carolina, 1889; reduced magnetic observations at Columbus, Ohio, and attended to some miscellaneous work.

Henry F. Flynn was engaged for eleven months on the reduction of latitude observations made at San Francisco, California, 1891–'92, for the purpose of investigating the law of variation of latitude. He also computed the heights of the stations in the trigonometrical survey of Yakutat Bay, Alaska, 1892, and attended to some geodetic miscellanies.

Lilian Pike was mainly engaged in computation of star places and otherwise advancing the computation for latitude of San Francisco, California, 1891–'92. Miss Pike also computed geographical positions of stations between Ross Mountain and Point Arena, California, and attended to miscellaneous geodetic computions, including solution of equations.

Alexander S. Christie was only connected with this Division during part of July, 1893, when he assisted in the computations for latitude of San Francisco, California, 1891–'92.

Harrison L. Stidham assisted in the computation for latitude of San Francisco, California, 1891–'92, between November, 1893, and February, 1894.

John F. Hayford, during March and April, 1894, assisted in the reduction of the San Francisco latitude, 1891–'92.

John Nelson was engaged during the two weeks of his connection with this Division in miscellaneous computations.

Daniel Hurley attended to the clerical duties of the Division, and in particular prepared copies of descriptions of trigonometrical stations required by field parties. He also attended to revisions, and during about one month was engaged on work assigned by the Assistant in Charge of office.

Yours, respectfully,

CHAS. A. SCHOTT,
Assistant in Charge of Computing Division.

Mr. B. A. COLONNA,
Assistant in Charge of the Office.

REPORT OF THE TIDAL DIVISION, U. S. COAST AND GEODETIC SURVEY OFFICE, FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

TIDAL DIVISION, *August 30, 1894.*

SIR: I have the honor to submit the following report of the Tidal Division for the fiscal year ending June 30, 1894:

SUMMARY OF THE WORK DONE DURING THE YEAR.

The tide tables for the Atlantic and Pacific coasts for 1895 were prepared for publication, and both volumes were read and revised in proof. The following are the principal changes which were made in the Atlantic Coast Tide Tables for 1895: (1) A table was introduced to enable mariners to find the height of the tide at any time. (2) The current tables were improved in form and a number of new stations added. (3) The table of tidal differences was increased by the addition of thirty-two stations. (4) The table of tidal constants was remodeled so as to supply the elements necessary for furnishing tide notes for charts. (5) The alphabetical list of tidal stations was placed at the end of the volume to serve as an index. The double reference to both tables, 1 and 2, was discontinued, and a plain page reference given instead.

The principal changes in the Pacific Coast Tide Tables for 1895 were the following: (1) The name of the volume was changed to Tide Tables for the Pacific Coast of America. (2) A table was introduced to enable mariners to find the height of the tide at any time. (3) Full predictions were made for the first time for Honolulu and Panama. (4) The number of subordinate stations was more than doubled by adding the most important ports on the west coast of South America, in Eastern Asia, Australia, and the islands of the Pacific

Ocean. (5) The table of tidal constants was remodeled and very much extended in order to supply the elements necessary for furnishing tide notes for charts; and it was combined with the tables of differences and geographic positions so as to present all the information about any station at a single opening. (6) A system of marking intervals so as to indicate whether a great or a small tide will result from the use of a given transit, was introduced. (7) The special tables of former years for sunrise and sunset which applied to only four stations, were replaced by a general table giving these times for whole earth. (8) In the explanation of tables various formulæ were used showing not only their construction, but how to approximately derive a number of additional constants from those which are given.

Our tide tables now cover about half of the seacoast of the world, and it is hoped that in the near future our predictions may be extended to all the principal commercial ports. With a view to accomplishing this result without having too large a volume, a form for publication was submitted to the Superintendent which, in addition to the great condensation incident to giving three months upon one page, is believed to be more convenient and to contain more information than any form which has been heretofore used.

In order to extend our information about the tides in foreign waters, on March 12, 1894, Dr. T. C. Mendenhall addressed the Secretary of the Treasury, asking him to request the Secretary of State to send a circular letter to the consular and diplomatic agents of the United States, instructing them to give us answers to our questions so far as they were able to secure such information from the governments to which they are accredited. In response to these circulars we have received much valuable information, and it gives me pleasure to testify to the promptness and evident interest with which our foreign legations entered into this matter.

It is gratifying to note the widespread interest in tidal questions, which is not limited to European and our own coasts. Many remote countries in Africa and Asia gave very satisfactory replies to our questions, and it is worthy of special remark that the Japanese furnished us the principal harmonic constants for forty-five ports.

An harmonic analysis has been completed for a year of observation at Honolulu, Hawaiian Islands, and at Panama, Colombia. At Portland, Maine, the analysis of a year has been almost completed. Four months have been added to the eight months previously reported for Newport, Rhode Island, thus completing the analysis of a year for this station. An harmonic analysis is in progress for Philadelphia, Pennsylvania, and Old Point Comfort, Virginia. The total work done on harmonic analysis during the year is the equivalent of the complete analysis of about four years.

The nonharmonic reductions completed during the year consist of sixteen series, the equivalent of about three and a half years of continuous observations, which have been discussed by the first or interval reduction method; and of eleven series, the equivalent of about three years of continuous observations, for which second or phase reductions have been made.

Tide notes have been prepared and furnished for one hundred and fourteen stations on thirty-six charts.

Requisitions from fourteen field parties have been filled, involving the description of seventy-six bench marks, and tidal data for thirty-five stations.

Tidal information has been called for by forty persons not connected with the Survey, the response to which required the preparation of fifty descriptions of bench marks, current tables for eight stations, tidal data for forty-four stations, and the writing of many technical letters requiring research in their preparation.

An aggregate of about seventeen years of record from automatic tide gauges has been received, examined, and registered. This includes about eight and a half years of record from Fort Sumter, Charleston Harbor, South Carolina, made under the direction of the United States Engineer Corps; about a year and a half of record from Lake Michigan, at Chicago, Illinois, and tracings from the Hawaiian Government Survey of the tide-gauge record at Honolulu for the entire year. About three years of tabulated hourly heights of the sea, high and low waters, temperature and density of the sea, and meteorological data, as also fifty-eight original and the same number of duplicate volumes of tidal observations from staff and box gauges, were received.

The need of a manual on tides and tidal phenomena has long been felt in this Division in order to systematize the work, and to have a ready means of answering numerous inquiries concerning tides. The preparation of such a volume was assigned to Dr. Rollin A. Harris, who by his former contributions to the advancement of the work of this Division, had proved himself well qualified for the task. In connection with this work, auxiliary tables have been prepared under his direction, as rapidly as our inadequate force could spare the time from necessary routine labors. The portion having the most direct bearing upon the production of the tide tables has been nearly completed; it applies to the reduction, the classification, and the prediction of tides.

It is important that all results from the reduction of observations should be reduced to their mean values, so that those obtained from various years may be comparable with one another. Want of attention to this detail has rendered many determinations of the range of tide, height, inequalities, etc., heretofore made by the Survey, somewhat uncertain and often inconsistent. Tables have now been prepared which enable us to readily pass from the particular to the mean value for a station, and the elements for prediction may be approximately obtained from the reduction of high and low waters.

In order to obtain good predictions for a subordinate station referred to a principal port for which full predictions are given, it is necessary that their tides be similar in type. Heretofore the Survey has had no criteria by which the class or type of tide could be readily obtained. Such criteria have now been developed and found to be extremely simple in their application.

An analytical method of predicting tides from their harmonic elements has been devised, which will serve as a check upon the working of the tide-predicting machine and supply parties with a means of making their own predictions.

The equilibrium arguments $V_0 + u$ and the factors F and f for reduction of tides have been computed and tabulated for Greenwich midnight. Beginning each year from 1850 to 1950 suitable interpolation tables have been made so as to adapt the tabular values to any other longitude and date. These tables are indispensable for both the analysis and the prediction of tides.

During the past year Mr. F. M. Little, of this Division devised a chronograph attachment which records on the tide curve or maregram the position of the pencil at each exact hour. He suggested a means of increasing the range of our automatic tide gauges without diminishing its scale; a tension spring which reduces to practical uniformity the work of the driving clock of the gauge; and a reading board for tabulating maregrams.

The ladies of this Division assisted in the preparation of many tables requiring more intelligence and care than their grade in the service would warrant one to expect from them; and it gives me pleasure to state that they have been efficient and zealous in their work.

Assistant G. A. Fairfield was in charge of the Division until June 8, 1894, when he was given temporary charge of the Engraving Division, and Mr. L. P. Shidy made Acting Chief of the Division. Assistant G. A. Fairfield served all the year until June 8; Messrs. L. P. Shidy, F. M. Little, R. A. Harris, Mrs. Virginia Harrison, Miss Alice Reville, and Miss Florence Brower were employed throughout the year. Mr. F. V. Moss was temporarily engaged from September 28, 1893, to the end of the fiscal year.

The working force of this Division for many years past has been barely sufficient to carry on the routine work of preparing tide tables and supplying calls for information, and consequently it has been impossible to make use of many valuable observations which have been received and filed in our archives. We need the results from all these records to improve our tide tables, yet year after year we are compelled to get along without them, because it is impossible with our present force to prevent getting more and more behindhand in our reductions. We already have an aggregate of about three hundred years of tidal record from automatic gauges which has never been discussed, and there are hundreds of volumes of unreduced staff observations, as well as very many volumes of observations on the currents. There is an urgent necessity for increasing our force if the Government is to derive any benefit whatever from the expensive observations it has paid for. If our present force were doubled it would require about fifteen years to discuss the vast accumulation of unused records already on hand.

Respectfully, yours,

L. P. SHIDY,
Acting Chief of the Tidal Division.

MR. B. A. COLONNA,
Assistant in charge of the Office.

REPORT OF THE DRAWING DIVISION, U. S. COAST AND GEODETIC SURVEY OFFICE, FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

DRAWING DIVISION, *September 28, 1894.*

SIR: I have the honor to submit the annual report of the Drawing Division for the fiscal year ending June 30, 1894. The changes in the personnel have been as follows:

Mr. Asa G. Randall, transferred to the Chart Division August 1, 1893.

Mr. E. S. Mitchell, retired on account of sickness June 26, 1894.

Mr. W. R. Doores and Mr. F. W. Clay, appointed draughtsman through Civil Service examination on November 21, 1893. Mr. Clay was immediately transferred to the Hydrographic Division.

The general assignment of work has been the same as in previous years.

Mr. A. Lindenkohl has been employed in collecting information, correcting and revising the published charts, and in constructing projections on copper.

Mr. H. Lindenkohl, in reductions and drawings for charts to be published by engraving or by photolithography.

Mr. E. H. Fowler, in the reduction of the survey of the District of Columbia for photolithographing and in constructing projections for field use.

Mr. E. J. Sommer, on drawings for the progress sketches along or near the thirty-ninth parallel until October 15, since then on the computation and adjustment of the work in southeastern Alaska.

Mr. D. M. Hildreth, on drawing for charts to be published by photolithography, in correcting and verifying the section maps of the District of Columbia, and in making projections for field use.

Mr. C. H. Deetz, on drawings for charts published by photolithography, projections for field parties, and clerical work.

Mr. G. F. Pohlers, on photolithographic drawings and sketches for illustrating the annual report.

Mr. E. P. Ellis, on drawings for photolithographing, lettering plane-table sheets, and on tracings.

Mr. Paul von Erichsen has been engaged on drawings of instruments, and in inking and completing original plane-table sheets.

Mr. C. Mahon, on reductions for engraved charts until the 15th of February, when on account of defective eyesight he was unable to continue; he has since been employed in clerical work for the assistant in charge.

Mr. E. S. Mitchell, Asa G. Randall, and W. R. Doores on miscellaneous tracings and in lettering and completing original plane-table sheets.

During the year drawings have been completed for twenty-six new charts and thirteen new editions of charts for publication by photolithography, eighteen new charts and thirteen new editions of charts for engraving. Thirty-five drawings were made for publication illustrating the annual report. Twenty-nine section maps of the District of Columbia have been verified for engraving. Thirty-four topographic and seventy-three hydrographic projections were constructed for field use. A large number of original plane table sheets have been inked and prepared for registration, and the usual number of minor corrections applied to the regularly published charts. In response to calls from the several Departments of the Government and from the general public, a great amount of information has been furnished, a list of which is appended (see table No. 3).

I have pleasure in testifying to the general interest in the work and close attention to their duties of the employees of the Division.

Respectfully, yours,

W. H. Dennis,
Assistant, and Chief of the Drawing Division.

Mr. B. A. Colonna,
Assistant in charge of the Office.

REPORT OF THE ENGRAVING DIVISION, U. S. COAST AND GEODETIC SURVEY OFFICE, FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

Engraving Division, *August 14, 1894.*

Sir: I respectfully submit the following report of the operations of this Division during the fiscal year ending June 30, 1894:

The statistics are as follows:

ENGRAVING.

Number of new charts completed	18
Number of new editions of charts completed	13
Number of sketches and illustrations completed	3
Number of new printing plates reissued	1
Number of section maps of the District of Columbia completed (four plates each)	12
Number of new charts commenced	15
Number of new editions of charts commenced	10
Number of sketches and illustrations commenced	10
Number of section maps of the District of Columbia commenced (four plates each)	17
Number of printing plates—reissued, commenced	2
Number of chart plates corrected for printing	572
Number of chart plates printed for chart room	704
Number of sketches and illustrations corrected for printing	59
Number of plates in progress during the year not completed	35
Number of unfinished plates on hand at the close of the year, viz:	
New charts	22
New editions of charts	19
Sketches and illustrations	52

ELECTROTYPING.

Number of pounds of copper deposited	2 937
Number of square inches on which deposit was made	111 247

Number of plates made, viz:		
Bassos	41	
Altos	51	
Total		92

Of this number one basso and fourteen alto plates were made for the Hydrographic Office, Navy Department.

PHOTOGRAPHING.

Number of negatives made	218
Number of blue prints made	3 302
Number of silver prints made	467
Number of silver prints made for the Navy Department	144
Number of lantern slides made	51
Number of chronograph scales made	3
Number of black prints made	23

PRINTING.

Number of impressions for the chart room	42 046
Number of impressions for Assistant in charge of the Office	1 718
Number of impressions for Hydrographic Inspector	25
Number of impressions for Engraving Division	784
Number of impressions for lithographer's transfer proofs	75
Total number of impressions	44 648

The force of engravers has remained as reported in the annual report ending June 30, 1893.

The three new engravers reported as commencing work April 17, 1893, have continued throughout the fiscal year 1894, and have shown themselves as capable of doing excellent work.

The old or expert engravers have been employed as heretofore on the branches of work they have made specialties, with the exception of such interruption as was necessary through the corrections arising from resurveys and work necessary to prepare the plates for publication. The young men who have heretofore been considered as under instructions have all made such satisfactory progress that they have been advanced and are now considered good engravers and add very much to the strength and output of the work of the Division.

Contracts for engraving were given out during the latter part of the year to Messrs. Evans and Bartle of this city, to engrave three plates, viz: Chart No. 8100, Clarence Strait, Revillagigedo Channel and Portland Canal, scale 1–200 000; Chart No. 8200, Sumner Strait and Frederick Sound, scale 1–200 000; Chart No. 8300, Lynn Canal and Stephens Passage, scale 1–200 000, all of southeastern Alaska; also seventeen sets of plates, sixty-three in number, of the Topographic Map of the District of Columbia, four sets of which were completed and the balance of the work is well advanced.

The most important engravings completed during the year were Chart B—Chesapeake Bay to Jupiter Inlet, scale 1–200 000; Chart C—The Straits of Florida and Approaches, scale 1–200 000, being entirely new engravings in one plate each, giving greater detail than was shown on the former editions.

The number of original charts, and plates of new editions of charts completed during the year is far in excess of what has heretofore been reported, and embrace a great deal of new work and recent surveys.

A large number of important plates were continued during the year and many of them advanced so far that they will be completed and published very rapidly during the present fiscal year.

The requisitions for printing from the chart room have decreased during the fiscal year 1894 by about 3 500 copies, as compared with the work of the last year, 1893, although there were fifty-five plates more corrected for printing than in the previous year; but the orders were not so large, being reduced to correspond with the demand.

The improved facilities of the printing rooms have enabled us to readily keep up with the demand and to overcome the serious annoyance of previous years, and the charts are promptly issued to the public.

The registration of the photolithograph work has been continued in this Division for the fiscal year 1894. Thirty-nine new charts, new editions, new prints, and reprints were furnished during the year, making an aggregate of 10 200 copies.

The plate printing office has continued under the direction of Mr. F. Moore, foreman. The force of printers has remained unchanged with the exception of the removal of Wm. H. Horne, printer's helper, August 9, 1893, and the appointment of Paul Dexter in his place, October 23, 1893; and the resignation of Otto Kemmler, May 6, 1894, and the appointment of Frank C. Gohre, May 8, 1894.

The electrotype and photograph rooms have continued under the charge of Mr. D. C. Chapman, assisted by Mr. Louis P. Keyser. The work of this branch of the Division has greatly increased compared with the work in 1893.

The general work of the Division has been performed by Mr. John H. Smoot in his usual acceptable manner, and the correspondence and detail work in regard to photolithographing by Mr. Eugene Rhodes, who has performed his duties very satisfactorily.

The Chief of the Engraving Division, Assistant H. G. Ogden, having been ordered on special duty June 9, 1894, to make a resurvey of a portion of Boston Harbor, Massachusetts, I was assigned to this Division by the Superintendent, and took charge as Acting Chief of the Division June 11, 1894, and with my little experience as such, I must say that the work has progressed to my entire satisfaction, and for the good generally of the Office.

Respectfully, yours,

GEORGE A. FAIRFIELD,
Assistant, and Acting Chief of the Engraving Division.

Mr. B. A. COLONNA,
Assistant in Charge of the Office.

REPORT OF THE CHART DIVISION, U. S. COAST AND GEODETIC SURVEY OFFICE, FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

CHART DIVISION, *August 17, 1894.*

SIR: This Division has been under my charge during the year, and the following-named persons have been attached to it, whose general duties have been as noted:

Miss L. A. Mapes, bookkeeping and correspondence.
Mr. H. R. Garland, issuing and correcting charts.
Mr. J. H. Barker, correcting charts.
Miss M. L. Handlan, coloring charts.
Mr. Neil Bryant, receiving and stamping charts.
Mr. R. T. Bassett, mounting sheets and joining charts.
Mr. J. W. Whitaker, correcting charts.
Mr. T. V. Walker, correcting and coloring charts.
Mr. Ivy Hill, correcting catalogues and coloring charts.
Mr. W. R. White, messenger.
Mr. A. G. Randall, correcting charts.
Mr. H. Sidney King, coloring and correcting charts.
Mr. W. P. Mangum, coloring charts.
Mr. J. K. Hagmann, messenger.
Mr. A. Upperman, mounting sheets and joining charts.

The changes in the force have been as follows:

Mr. A. G. Randall, transferred from Drawing Division August 1.
Mr. T. V. Walker, transferred to Post-Office Department August 26.
Mr. H. Sidney King, assigned August 28.
Mr. Wm. R. White, resigned September 6.
Mr. Ivy Hill, transferred to Third Auditor's Office, Treasury Department, September 9.
Mr. W. P. Mangum, assigned September 29.
Mr. J. W. Whitaker, transferred to Second Auditor's Office, Treasury Department, October 3.
Mr. J. K. Hagmann, assigned October 5.
Mr. W. P. Mangum, transferred to Library and Archives Division November 30.
Mr. A. Upperman, transferred from Office January 1.
Mr. R. T. Bassett, died February 8.

With the exception of the transfers, resignation, and death above noted, the persons named are still on duty here.

The following table represents in brief the more important features of the relation of the chart issue of this year to that of the five years next preceding:

Comparison of issues of charts during the fiscal years noted below.

		1889.	Change. + or —	1890.	Change. + or —	1891.	Change. + or —	1892.	Change. + or —	1893.	Change. + or —	1894.
Totals	Copies	49 312	+13 840	63 152	—10 193	52 959	—284	52 675	+2 351	55 026	—3 355	51 671
	Values	$20 096	+$6 082	$26 178	—$2 721	$23 457	—$416	$23 041	+$1 174	$24 215	—$1 739	$22 476
Free	Copies	21 088	+9 024	30 112	—9 301	20 811	+2 640	23 451	+3 859	27 310	+392	27 702
	Values	$8 266	+$3 855	$12 121	—$3 275	$8 846	+$985	$9 831	+$1 974	$11 805	+$40	$11 845
Gross sales	Copies	28 244	+4 816	33 040	—892	32 148	—2 924	29 224	—1 508	27 716	—3 447	23 969
	Values	$11 830	+$2 227	$14 057	—$554	$14 611	—$1 402	$13 209	—$800	$12 409	—$1 778	$10 631
Net sales	Copies	26 540	+5 266	31 806	—3 333	28 473	—1 259	27 214	—1 848	25 366	—4 136	21 230
	Values	$11 280	+$2 295	$13 575	—$434	$13 141	—$635	$12 506	—$901	$11 605	—$2 010	$9 595

The total issue is 6 per cent smaller than that of last year, and 5 per cent smaller than the average of the five preceding years, and the net sales, i. e., the gross sales less charts returned by sales agents, have also decreased, being about 17 per cent in copies and value less than those of last year, and about 23 per cent less in copies and value, as compared with the average of the five previous years. The decrease in sales may partly be accounted for by the general depression of business throughout the country.

The distribution of charts to libraries, referred to in my last two annual reports, has been continued, and all who have accepted the offer have been supplied with a set including our principal charts and, in many cases, a number of the minor charts have been furnished. It is proposed to continue the distribution as opportunity serves until each library has a full set.

A new edition of the Chart Catalogue is in press and may be expected in the near future. It is hoped that a new edition can be published each year. In the past year about 2 400 copies of the Catalogue of 1893 have been distributed.

The correspondence for the year has amounted to three thousand and seventy-nine (3 079) letters written.

Although the chart issue, as above stated, has been considerably less than that of previous years, it was found, as the summer season opened, that the force was inadequate for the work, and I was obliged, in June, to increase the hours of work for a time and to procure temporary help from the Office. The force of the Division in that month numbered nine, as compared to ten in June, 1893, and eleven in June, 1892, while the amount of correction and coloring to be applied to the charts has been steadily increasing.

Six new charts from copperplate, and eighteen new lithographic charts, twenty-four in all, have been delivered to this Division for issue during the past year, viz:

Date.	Catalogue No.	Title.
1893.		ENGRAVED.
Aug. 23	5400	Point Buchon to Point Pinos.
Oct. 9	299	Peconic Bay, Long Island.
Nov. 13	5923	Hunter Cove and Mack Reef.
Dec. 6	"C"	The straits of Florida and approaches.
Dec. 6	301	Eastport to Moose Cove, including Cobscook Bay.
1894.		
June 1	51	Nantucket Shoals to Montauk Point.
1893.		LITHOGRAPHED.
July 1	3054	City of San Francisco and vicinity.
July 6	6377	Bellingham Bay.
July 19	8235	Gastineau Channel and part of Stephens Passage.
Aug. 3	8229	Slocum and Limestone inlets and Taku Harbor.
Aug. 3	6303	Port Angeles.
Aug. 11	6185	Willapa Bay.
Aug. 12	411	Appomattox River from City Point to Petersburg.
Aug. 25	200	Vermilion Bay to Pecan Island.
Oct. 11	8227	Port Snettisham.
Dec. 8	270	Rye Neck to Little Captain Island.
Dec. 18	5144	Santa Monica Bay.
1894.		
Jan. 2	269	Little Captain Island to Stamford Harbor.
Jan. 2	271	New Rochelle to Rye Neck.
Mar. 19	268	Sheffield Island to Westcott Cove.
Mar. 26	9100	Aleutian Island, from Yunaska Island to Attu Island.
Apr. 20	260	Guilford to Blackstone Rocks.
June 7	261	Blackstone Rocks to South End, including Bradford Bar.
June 28	267	George's Rock to Sheffield Island, including Saugatuck and Norwalk rivers.

Twenty new copperplate editions of charts and fourteen new lithographic editions, thirty-four in all, have been delivered to this Division.

The receipts, issues, and general distribution of charts are given in the following tables:

Issues.	July 1, 1893 to June 30, 1894.	
	Number.	Value.
Sales agents	23 540	$10 451·35
Sales by Office and Chart Division	437	190·35
Congressional account	3 373	1 549·95
Hydrographic Office, Navy	6 642	2 699·75
Light-House Board	2 355	883·15
Coast and Geodetic Survey	3 182	1 338·55
Executive Departments	2 347	933·80
Foreign Governments	1 204	459·30
Libraries	7 313	3 380·35
Miscellaneous	1 278	541·50
Totals	51 671	22 426·05
Condemned	5 747	2 295·20
Total issued and condemned	57 418	24 721·25

Charts on hand and received from July 1, 1893, to June 30, 1894.

	Number.	Value.
On hand by count July 1, 1893	42 273	$16 037·45
Received July 1, 1893, to June 30, 1894 (plate)	41 176	18 116·35
Received July 1, 1893, to June 30, 1894 (stone)	13 640	5 223·05
Returned	2 762	1 058·50
Total on hand and received June 30, 1894	99 851	40 435·35
Total issued and condemned June 30, 1894	57 418	24 721·25
On hand by book July 1, 1894	42 433	15 714·10
Difference between book and count	73	36·80
On hand by count July 1, 1894	42 360	15 677·30

Very respectfully, yours,

GERSHOM BRADFORD,
Assistant, and Chief of the Chart Division.

MR. B. A. COLONNA,
Assistant in charge of the Office.

REPORT OF THE MISCELLANEOUS DIVISION, U. S. COAST AND GEODETIC SURVEY OFFICE, FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

MISCELLANEOUS DIVISION, *September 29, 1894.*

SIR: I have the honor to submit herewith the report of the Miscellaneous Division for the fiscal year ending June 30, 1894.

The volume of work done in the Division, so far as it is susceptible of tabulation, is shown by the following figures:

Letters written (sales agents, 2 403; miscellaneous, 437)	2 840
Ledger accounts kept (sales agents)	94
Quarterly statements of sales agents examined and verified	281
Circulars to sales agents issued	29
Charts sent to sales agents	23 540
Orders for purchases issued	436
Requisitions made for printing and binding	81
Requisitions for stationery filled	498
Requisitions for miscellaneous supplies and repairs filled	308
Annual Reports distributed (see tabulated statement)	3 290
Tide Tables issued	4 588
Atlantic Coast Pilots issued	3
Subdivisions, Atlantic Local Coast Pilot, issued	240
United States Coast Pilots, Atlantic Coast, issued	589
Pacific Coast Pilot, Alaska, Part I, issued	59
Pacific Coast Pilot, "California, Oregon, and Washington," issued	31

The number of charts sent to sales agents during the year, viz, 23 540, was 3 440 copies less than were issued during the previous fiscal year.

Six agencies for the sale of publications—two on the Atlantic Coast and four on the Pacific Coast—were established during the year, and fifteen were discontinued—ten on the Atlantic and Gulf coasts, and five on the Pacific Coast. The total number of agencies on June 30, 1894, was eighty-four—sixty-four on the Atlantic and Gulf coasts and twenty on the Pacific Coast.

The aggregate of business done through the agencies from July 1, 1893, to June 30, 1894, is shown by the following table:

PUBLICATIONS.	In hands of sales agents July 1, 1893.		Issued to sales agents during the year.		Sales by agents during the year.				Returned by sales agents during the year.		In hands of sales agents June 30, 1894.	
	No. of copies.	Value.	No. of copies.	Value.	No. of copies.	Value.	Commission allowed.	Net am't received.	No. of copies.	Value.	No. of copies.	Value.
Charts	24 561	$9 725·75	23 540	$10 451·35	21 074	$9 564·10	$4 781·10	$4 783·00	2 730	$1 043·80	24 297	$9 569·20
Tide Tables	1 529	382·25	3 664	916·00	4 161	1 040·25	519·91	520·34	270	67·50	762	190·50
Atlantic Coast Pilots	37	129·50	3	10·50	7	24·50	5·25	19·25	19	66·50	14	49·00
Subdivisions, Atlantic Local Coast Pilot	293	202·55	104	80·00	104	78·95	16·70	62·25	118	82·85	175	120·75
United States Coast Pilots—Atlantic Coast	134	134·00	258	258·00	188	188·00	47·00	141·00	4	4·00	200	200·00
Pacific Coast Pilot—Alaska, Part I	144	288·00	33	66·00	41	82·00	20·50	61·50	1	2·00	135	270·00
Pacific Coast Pilot—"California, Oregon, and Washington"	83	332·00	21	84·00	26	104·00	26·00	78·00	1	4·00	77	308·00
Totals of value	--------	11 194·05	--------	11 865·85	--------	11 081·80	5 416·46	5 665·34	--------	1 270·65	--------	10 707·45

The following table shows the amount of sales of publications on the Eastern and Western coasts respectively, during the year.

PUBLICATIONS.	Atlantic and Gulf Coasts.				Pacific Coast.			
	No. of copies.	Value.	Amount of commission allowed.	Net am't received.	No. of copies.	Value.	Amount of commission allowed.	Net am't received.
Charts	18 417	$8 422·65	$4 210·45	$4 212·20	2 657	$1 141·45	$570·65	$570·80
Tide Tables	1 149	287·25	143·47	143·78	3 012	753·00	376·44	376·56
Atlantic Coast Pilots	7	24·50	5·25	19·25	--------	--------	--------	--------
Subdivisions, Atlantic Local Coast Pilot	104	78·95	16·70	62·25	--------	--------	--------	--------
United States Coast Pilots—Atlantic Coast	188	188·00	47·00	141·00	--------	--------	--------	--------
Pacific Coast Pilot—Alaska—Part I	19	38·00	9·50	28·50	22	44·00	11·00	33·00
Pacific Coast Pilot—"California, Oregon, and Washington"	1	4·00	1·00	3·00	25	100·00	25·00	75·00
Totals of value	--------	9 043·35	4 433·37	4 609·98	--------	2 038·45	983·09	1 055·36

The following publications were sent to press: Annual Report of the Superintendent for the year ending June 30, 1892; United States Coast Pilot, Atlantic Coast, Part V—"From New York to Chesapeake Bay Entrance;" Tide Tables for the Atlantic Coast of the United States for the year 1895; Tide Tables for the Pacific Coast of America for the year 1895; Catalogue of Charts and other Publications, 1894; General Instructions for Hydrographic Parties; Bulletins Nos. 28, 29, 30; Notices to Mariners Nos. 168 to 180, inclusive; and Appendices Nos. 1 to 12 inclusive, to the Annual Report of the Superintendent for the fiscal year ending June 30, 1892, to be printed separately in pamphlet form.

The usual distribution was made of the Annual Reports of the Superintendent, the Appendices to the same printed separately in pamphlet form, Bulletins, and Notices to Mariners, and they were also furnished in large numbers in response to numerous special applications. The distribution of Annual Reports was as follows:

Date of report.	Domestic distribution.		Foreign distribution.		Totals.
	To institutions.	To individuals.	To institutions.	To individuals.	
1851	2	----------	----------	----------	2
1852	1	----------	1	----------	2
1853	2	1	1	----------	4
1854	3	1	1	----------	5
1855	2	----------	1	----------	3
1856	3	2	1	----------	6
1857	2	----------	----------	----------	2
1858	2	----------	1	----------	3
1859	2	1	----------	----------	3
1860	2	4	1	----------	7
1861	3	1	1	----------	5
1862	2	----------	----------	----------	2
1863	1	----------	1	----------	2
1864	1	----------	----------	----------	1
1865	4	----------	1	1	6
1866	5	2	1	1	9
1867	4	1	1	1	7
1868	4	2	1	1	8
1869	2	----------	----------	1	3
1870	2	1	1	1	5
1871	6	----------	2	1	9
1872	8	----------	3	1	12
1873	19	5	7	1	32
1874	20	9	7	1	37
1875	21	8	7	1	37
1876	22	12	7	1	42
1877	21	8	7	1	37
1878	20	6	7	1	34
1879	35	13	7	2	57
1880	35	51	8	4	98
1881	22	23	8	6	59
1882	23	28	9	7	67
1883	24	35	8	9	76
1884	30	52	9	9	100
1885	24	21	8	6	59
1886	23	26	8	6	63
1887	23	27	8	6	64
1888	22	36	9	7	74
1889	25	49	8	8	90
1890	42	113	8	8	171
1891—Part I	189	150	74	1	414
1891—Part II	718	597	240	18	1 573
Totals	1 421	1 285	473	111	3 290

Following is a list of the publications of the Survey, with the number of copies of each received during the year from the Public Printer:

Name of publication.	No. of copies.
Report of the Superintendent of the U. S. Coast and Geodetic Survey for the fiscal year ending June 30, 1891, Part I.	701
Report of the Superintendent of the U. S. Coast and Geodetic Survey for the fiscal year ending June 30, 1891, Part II.	2 000
Report of the Superintendent of the U. S. Coast and Geodetic Survey for the fiscal year ending June 30, 1892, Part II.	2 000
United States Coast Pilot—Atlantic Coast, Part III, "From Cape Ann to Point Judith."	1 500
United States Coast Pilot—Atlantic Coast, Part V, "From New York to Chesapeake Bay Entrance."	600
Tide Tables for the Atlantic Coast of the United States, together with 207 stations on the Atlantic Coast of British America, for the year 1895.	2 026
Errata slip for the Atlantic Coast Tide Tables for 1894	1 500
Catalogue of Charts and other Publications, 1893	2 206
House Executive Document No. 157, 53d Congress, 2d Session—"Expenditures Coast and Geodetic Survey, 1893."	200
General Instructions for Hydrographic Parties	500
Bulletin No. 1 (reprint)	1 000
Title Page and Table of Contents for Bulletins—Vol. 1, Nos. 1 to 25.	3 000
Bulletin No. 27—"Results of Observations for the Variations of Latitude at Waikiki, Hawaiian Islands."	3 000
Bulletin No. 28—"The Constant of Aberration as Determined from a Discussion of Results for Latitude at Waikiki, Hawaiian Islands."	3 400
Bulletin No. 29—"The Methods and Results of the U. S. Coast and Geodetic Survey, as Illustrated by its Exhibit at the World's Columbian Exposition, 1893."	3 000
Bulletin No. 30—"Units of Electrical Measure"	5 000
Pamphlets descriptive of various items of the Coast and Geodetic Survey Exhibit at the World's Columbian Exposition, viz:	
"The U. S. Coast and Geodetic Survey"	10 000
"Base Apparatus"	5 000
"Triangulation and Reconnaissance"	5 000
"Time, Latitude, and Longitude"	5 000
"Gravity"	5 000
"Topography"	5 000
"Hypsometry"	5 000
"Hydrography"	10 000
"Tides and Currents"	10 000
"Description of the Coast and Geodetic Survey Steamer *Blake* and her Deep-Sea Apparatus."	10 000
"Magnetics"	5 000
"Chart Publications"	5 000
"Weights and Measures"	5 000
"Model of United States and Alaska"	10 000
Appendix No. 14, Report for 1891—"Report of an Expedition to Muir Glacier, Alaska."	200
Appendix No. 16, Report for 1891—"Proceedings of the Topographical Conference, Washington, D. C., 1892."	1 000
Appendix No. 1, Report for 1892—"On the Variation of Latitude at Rockville, Maryland, from Observations made in Cooperation with the International Geodetic Association, 1891-1892."	500
Appendix No. 2, Report for 1892—"On the Variation of Latitude at Waikiki, near Honolulu, Hawaiian Islands, from Observations made in Cooperation with the International Geodetic Association, 1891, 1892."	500
Appendix No. 3, Report for 1892—"Heights from Geodetic Leveling between Okolona, Mississippi, and Odin, Illinois, 1885, and 1888-1890."	300
Appendix No. 4, Report for 1892—"Heights from Geodetic Leveling between Corinth, Mississippi, and Memphis, Tennessee, 1890-1891."	300
Appendix No. 5, Report for 1892—"On the Tides and Currents in the Harbor of Edgartown and Katama Bay, Marthas Vineyard."	300
Appendix No. 6, Report for 1892—"On the changes in the Ocean Shore Lines of Nantucket Island from a Comparison of Surveys made between 1846 and 1887 and 1891."	300
Appendix No. 7, Report for 1892—"Results of Magnetic Observations recorded at Los Angeles, California, 1882-1889."	500
Appendix No. 8, Report for 1892—"On the Measurement of the Base Lines at Holton, Indiana, and at St. Albans, West Virginia, 1891 and 1892."	1 200
Appendix No. 9, Report for 1892—"The Micrometer Screw: Measure of the Irregularity in one Turn and Relative Value of each Turn."	200
Appendix No. 10, Report for 1892—"On the Least Square Adjustment of Weighings."	200
Appendix No. 11, Report for 1892—"Results of Magnetic Observations at Stations in Alaska and in the Northwest Territory of the Dominion of Canada."	300
Appendix No. 12, Report for 1892—"On the Direct Synthetical Method of Adjusting a Triangulation."	200
NOTICES TO MARINERS.	
No. 168, June 3, 1893—Chart corrections during the month	10 000
No. 169, July, 1893—Chart corrections during the month	10 000
No. 170, August, 1893—Chart corrections during the month	10 000
No. 171, September, 1893—Chart corrections during the month.	10 000
No. 172, October, 1893—Chart corrections during the month	10 000
No. 173, November, 1893—Chart corrections during the month.	10 000
No. 174, December, 1893—Chart corrections during the month.	10 000
No. 175—Index to chart corrections, January 1 to December 31, 1893.	10 000
No. 176, January, 1894—Chart corrections during the month	10 000
No. 177, February, 1894—Chart corrections during the month	10 000
No. 178, March, 1894—Chart corrections during the month	10 000
No. 179, April, 1894—Chart corrections during the month	10 000
No. 180, May, 1894—Chart corrections during the month	10 000

The following-named persons were employed in the Division during the year:

Freeman R. Green, clerk.
Harry J. Van Der Beek, stenographer.
J. A. Watts, engineer.
Walter P. Ramsey, janitor.
David Parker, watchman.
David Somerville, watchman. Resigned September 30, 1893.
John W. Drum, watchman. Appointed July 6, 1893.
J. A. McDowell, watchman. Appointed October 11, 1893.
William H. Butler, messenger. Reduced to Fireman October 28, 1893.
Charles Over, messenger.
Sandy Bruce, messenger. Dismissed September 25, 1893.
P. H. White, messenger. Appointed September 26, 1893. Dismissed March 2, 1894.
Charles H. Jones, messenger.
Attrell Richardson, messenger.
William Savoy, messenger. Dismissed January 28, 1894.
Ed. D. Scott, laborer and messenger. Appointed Oct. 21, 1893. Promoted March 3, 1894.
Thomas McGoines, messenger. Appointed April 3, 1894.
John W. Miner, messenger. Appointed May 7, 1894.
C. E. Yarboro, messenger. Appointed January 29, 1894. Died April 26, 1894.
W. R. McLane, driver.
Harrison Murray, fireman. Dismissed October 20, 1893.
Horace Dyer, fireman.
John H. Brown, laborer.
Boston Brown, laborer.
Sarah E. Flynn, laborer.
John H. Mason, laborer.
Samuel L. Eubank, laborer. Dismissed October 27, 1893.
Baylor Crutchfield, laborer. Appointed December 27, 1893.
William Young, extra laborer.
George Leach, extra laborer. From January 8, 1894, to January 31, 1894.
Edmunds G. Bell, extra laborer. From January 9, 1894, to January 17, 1894.
William N. Newbold, extra laborer. From January 18, 1894, to January 31, 1894.

Respectfully, yours,

M. W. Wines,
Chief of the Miscellaneous Division.

Mr. B. A. Colonna,
Assistant in Charge of the Office.

REPORT OF THE INSTRUMENT DIVISION, U. S. COAST AND GEODETIC SURVEY OFFICE, FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

Instrument Division, *August 8, 1894.*

Sir: I have the honor to submit the following report of the work of the Instrument Division during the fiscal year ending June 30, 1894:

This Division has to send out, receive, and account for all instruments and general property used in the field and in the various Divisions of the office, make the needed repairs to instruments, plan and construct new instruments, determine their constants so far as it is practicable to do so at the office, and purchase new instruments and all of the material necessary to the work of the Division. The force of the year has been as follows:

Edwin Smith, assistant, and chief of the Instrument Division.
William C. Maupin, clerk.
William West, messenger.
E. G. Fischer, chief instrument maker.
Otto Storm, instrument maker.
Clement Jacomini, instrument maker.
Jacob Schwarz, instrument maker.
W. R. Whitman, instrument maker.
S. A. Kearney, instrument maker.
C. E. Regennas, instrument maker.
M. Lauxmann, instrument maker.
H. O. French, carpenter.
G. W. Clarvoe, carpenter.
C. N. Darnall, carpenter.

From September 1 to September 30, I was absent from the office on official duty at the World's Columbian Exposition under instructions from the Superintendent and the Treasury Department. During this time the Division was in charge of Mr. E. G. Fischer, the chief instrument maker. Mr. Otto Storm, instrument maker, was also on duty at the World's Columbian Exposition during the month of July, and from August 1 to 9, 1893; Mr. E. G. Fischer, chief instrument maker, during the month of August; Mr. W. R. Whitman, instrument maker, during the month of September, and from October 1 to 15; and Mr. George W. Clarvoe, carpenter, from October 16 to November 25, 1893.

The instrument and carpenter shops are essentially repair and experimental shops, and the construction of new instruments is incidental to this work, being mostly confined to such instruments as can not be purchased in stock or made to order except at very much greater cost and delay.

The following tables Nos. I and II give statistics of repairs and new work, and table No. III a list of instruments and apparatus purchased.

TABLE No. I.

Repairs to Instruments—July 1, 1893, to June 30, 1894.

33 theodolites.
2 engineers' transits.
2 astronomical transits.
5 engineers' levels.
1 level rod.
2 geodetic leveling rods.
4 meridian telescopes.
4 vertical circles.
3 dip circles.
1 azimuth circle.
1 zenith telescope.
5 gradienters.
5 compass declinometers.
7 magnetometers.
18 plane tables.
17 plane-table alidades.
4 plane-table telemeters.
1 draw telescope.
10 reconnoitering telescopes.
19 heliotropes.
13 sextants.
12 protractors (three-arm).
9 binoculars.
1 azimuth compass.
2 aneroid barometers.
1 barometer testing apparatus.
4 chronographs.
2 current meters.
1 velocity register.
5 tide gauges.
1 tide-predicting machine.
1 beam compass.
4 metric scales.
1 steel tape.
3 pairs proportional dividers.
2 pendulum apparatus, A and B.
1 air pump.
1 compass ruling machine.
1 microscope stage.
2 hair frames.
1 dotting wheel.

Repair Work for Office of Standard Weights and Measures.

- 1 balance (Rhode Island).
- 1 large balance.
- 1 end measure adjusting apparatus.
- 1 vertical comparator.
- 1 model of prototype metre.
- 1 set of troy weights (Rhode Island).
- 2 sets of troy weights.
- 2 sets of metric weights.
- 4 sets of avoirdupois weights.
- 4 sets of 1, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{16}$ gallon measures.

TABLE No. II.

New Instruments made between July 1, 1893, and June 30, 1894.

- 3 pendulums for Apparatus B.
- 1 pendulum for Apparatus C, complete.
- 3 air pumps.
- 7 telemeters.
- 6 sets of telemeter fixtures.
- 2 reconnoitering telescopes, Nos. 157 and 158.
- 3 iron stands, Nos. 11, 12, and 13, for 12-inch theodolites.
- 1 heliotrope, No. 117.
- 5 footplates (extra) for geodetic leveling rods.
- 7 steel tapes, 25 and 50 metres.
- 12 thermometer cases.
- 3 universal levels.
- 48 large plane-table clamps.
- 48 screw plates and taps.
- 13 micrometer screws and heads (extra).

New Work for Office of Standard Weights and Measures.

- 5 liters.
- 5 decaliters.
- 5 steel metres.
- 5 meter cases.
- 12 weights, 25 and 50 grains.
- 6 weight cases.
- 6 small weight cases.
- Cases for standard measures.

TABLE No. III.

Instruments purchased between July 1, 1893, and June 30, 1894.

- 1 zenith telescope.
- 1 small electric chronograph.
- 1 special chronograph.
- 7 4-inch theodolites.
- 4 7-inch theodolites.
- 10 sextants.
- 18 binoculars.
- 6 zylonite half-circle protractors.
- 6 hard-rubber triangles.
- 1 set hard-rubber lettering triangles.
- 3 flat boxwood scales.
- 1 hard-rubber spline and 4 weights.
- 6 spring bow-pens.
- 6 steel straightedges.
- 31 steel tapes (six 5-ft., fifteen 50 ft., and ten 100-ft.)
- 1 range finder.
- 24 pocket magnifying glasses.
- 10 spring balances.
- 6 sling psychrometers.
- 1 maximum thermometer.
- 24 thermometers.
- 1 sounding register.
- 1 5 x 6 camera, complete.
- 1 Burroughs registering accountant.

One hundred and eighty-two requisitions have been received from field parties and the Office. The filling of many of these have required several days' work of several men. This work is only in part shown in the table of repairs.

The usual amount of work has been done for the Office in the care of clocks, electric bells, building shelves in the Archives and Library Division, making file cases, drawing boards, etc., and such general repairs about the building as could be done by the men of the instrument and carpenter shops. This class of work is always made subordinate to the regular work of the Division, but at times seriously hampers it.

Most of the repairs to the instruments were of a general character, and incidental to their use in the field; a few of them, however, require special mention.

Among the theodolites No. 146, one of the new 12-inch instruments made at the Office, had an old circle which proved to be too weak and to have a warped surface. A new circle was made for this instrument. This instrument and No. 145, its mate, have gone to the field this season for the first time. The work that may be done with them will be looked for with much interest. A third instrument of this character was required for field service this year and No. 118, purchased about 1875, was selected. New micrometers had to be put on this instrument, as well as many other repairs. The three new iron stands mentioned in Table II were for these instruments. These stands were made with great care, especially as to design, and it is believed their use will avoid the necessity of building expensive masonry piers.

The Survey has six 8-inch position theodolites which have been set aside for some years. One of these, No. 140, was put in the shop early in the spring. New micrometers were put on, the circle regraduated, and arrangement made by which the position of the circle could be shifted without moving it on the center. Many minor repairs were also made. It was thought these repairs would make it a fine instrument, but on examination the centers were found so faulty that the instrument could not be sent out. The centers of these instruments are single cones of bell metal with red metal sockets. No. 140 is now in the shop, where a new double-cone center of hardened steel with cast-iron socket is being made. A cover for the circle will also be added. It is expected that this instrument will prove so efficient as to lead to the reconstruction of several of the other five.

In May theodolite No. 115 (20-inch) was received at the Office from Professor Davidson for extensive repairs. Some time has been spent investigating this instrument, but thus far it has not been definitely decided what repairs will be made.

Meridian telescopes, No. 3, for Assistant Eimbeck's party and No. 13 for the gravity party, were so extensively remodeled as to make them practically new instruments.

It was deemed necessary to have at least two mounted knife-edges to each set of ½-second pendulum apparatus. As set A was wanted for the field, the mounted knife-edge of set B was transferred to set A, necessitating two mounted knife-edges to be made for set B. These are not yet quite finished. A set of three new pendulums (B4, B5, B6) were made for set B, to conform with the new set that had been made for apparatus A. In these pendulums the agate planes are mounted instead of knife-edges.

Last year an experimental ¼-second pendulum C was made. Experiments with it led to the construction of a complete apparatus known as C, with ¾-second pendulums known as C1, C2, C3. This apparatus is practically similar to sets A and B, except in size. The flash apparatus of this set is of a new design, and will be fully described in the first report of the observations made with the apparatus. Experience has shown the necessity of swinging the pendulums at very much lower pressures than had been the recent practice in the Survey. This necessitated much better air pumps, and these were made from designs, or rather an invention, by our chief instrument maker. These will also be fully described elsewhere.

Among the instruments purchased, the zenith telescope is ordered from Wanschaff, of Berlin, and the special chronograph from Fauth & Co., of Washington. These instruments will not be delivered for several months. They are both special instruments for the determination of geographical positions, and will be properly described in next year's report.

One of the 4-inch theodolites is by Buff & Berger, of Boston, and six by Fauth & Co., of Washington. They are specially designed for use by the reconnoitering and topographic parties. They are by far the finest instruments of the size the Survey has yet had and will supply a long-felt need.

The four 7-inch theodolites are by Buff & Berger, and are specially designed for the triangulation parties in Alaska and similar work.

The instruments, etc., which were exhibited at the World's Columbian Exposition in Chicago, were returned to the Office in December, 1893.

During the meeting of the Geodetic Conference at the Office in January and February, 1894, such a display of geodetic instruments as was practicable was made in the Instrument Division for the benefit of the Conference.

The efficiency of the shop has been increased by the addition of a 5-foot Pratt & Whitney planer and some smaller tools.

A detailed account of each day's work of each employee is kept on file. The books and accounts of the Division and the inventories of the field parties are now in a very satisfactory condition.

Respectfully, yours,

EDWIN SMITH,
Assistant, and Chief of the Instrument Division.

Mr. B. A. COLONNA,
Assistant in charge of the Office.

REPORT OF THE LIBRARY AND ARCHIVES DIVISION, U. S. COAST AND GEODETIC SURVEY OFFICE, FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

LIBRARY AND ARCHIVES DIVISION, *July 30, 1894.*

SIR: During the year ending June 30, 1894, the work in the Library and Archives Division has been vigorously prosecuted with the force which was available.

THE ARCHIVES.

The work of arranging the records has been continued and quite a number of volumes prepared for the bindery. During the year 129 volumes of tidal observations and 33 volumes of deep-sea records have been bound, and the bindery now has 150 volumes of geodetic records, and 196 volumes of sounding books. Total for the year, 508 volumes.

Eleven original sheets have been backed for preservation. The current records have been overhauled and provisionally arranged. The record cases in the hallway, main floor, have been rearranged so that they are all under lock and key, and access to them can only be obtained by applying to myself or one of my assistants.

The tidal records have been removed to the third-floor front room, and the old room turned over to the Weights and Measures Office for their Standards.

We have received a series of eleven years' tidal observations made at Charleston, South Carolina, for the Army Engineers.

Quite a large number of photographic negatives and prints have come in from field parties. Two sets of prints have been made from the negatives on file, for convenience in referring to them.

This is but a small start toward the entire work; for to examine the records individually, and see that they are properly prepared for binding, involved a large amount of work, since each volume as bound represents from five to ten as originally turned in, or else a large number of separate cahiers of computations, notes, etc. I trust that more clerical force may be given us to push this work during the coming year, so that a larger result may be shown. The trouble seems to be that the persons that are available for the work are not qualified to do it, owing to their lack of experience and knowledge of the operations of the Survey.

THE LIBRARY.

In the library the work has made more apparent progress. We have books numbered from 2121 to 14331, or 12211 volumes registered. All volumes which are in the library (except the Government publications), have been catalogued.

During the year we received by purchase, 347 volumes; by presentation, exchange, etc., 557 volumes; and from the bindery, 663 volumes; while there were rebound, or bound for the first time, 510 volumes, which were already entered. Total number of volumes sent to the bindery, 764.

The standard of the books purchased has been high, and the continuance of the present policy will soon make the library a very valuable one to any student of the subjects which are comprised among those which relate to the work of the Coast and Geodetic Survey. The subject of American (United States) history has received more attention, as has also that of electricity, the latter having been in a measure brought under the cognizance of the Office of Weights and Measures by the legislation legalizing the "Units of Electrical Standards."

Twenty or more charts have been backed for preservation. Letters were written to over fifty foreign and domestic scientific societies asking them to assist us in completing our sets of their publications. In response we have received many volumes and numbers which fill in gaps and make our files much more valuable than when in the incomplete and broken condition. Some volumes have also been purchased, and others we are on the lookout for, as they are out of print and can only be obtained when they appear in the second-hand dealer's lists. Among the sets which we have filled are: "The Proceedings of the Royal Society of London," "Transactions of the American Society of Civil Engineers," "Queensland Branch of the Royal Geographical Society of South Australia," "Transactions of the Seismological Society of Japan," and "Nature."

After the closing of the World's Columbian Exposition at Chicago we were presented with some very fine copies of Japanese maps, being facsimiles of work done by that nation at different intervals during 230 years, showing the development of cartography in that country. These are curiously framed in large bamboo frames. We also received as presents from the French Commissioners a number of beautifully executed maps, both engraved and lithographed, which formed a portion of the exhibit of the "Dépôt de la Guerre." Some of these were framed and others were in portfolios. With these was also a model showing the processes used by that office in constructing relief maps.

Twenty-six original topographic sheets were loaned to the United States Geological Survey to be photographed by them for use in constructing their maps.

The usual amount of office work was done. Inventories of books checked, letters written, and inquiries answered. I append hereto a table showing the receipts of this Division for the year, also the force of the Division during the same period. Messrs. Artemus Martin and John Dale have served continuously in the Division during the year, and it is largely owing to their experience and cheerful readiness that we have been able to accomplish the large amount of work along so many different lines, in addition to the current work.

Our map collection is slowly increasing, and becoming more and more valuable and oftener consulted. Desiring to obtain as complete information as possible about the maps of the United States, the following circular was sent to the Governors of all the States and Territories, November, 1893. (The District of Columbia was not addressed, as it is covered by United States maps.)

U. S. COAST AND GEODETIC SURVEY OFFICE,
Washington, D. C., November 11, 1893.

TO HIS EXCELLENCY,
THE GOVERNOR OF ————————————

SIR: This office is often called upon for geographical information, which fact renders it important that we should possess as complete files as possible of all maps relating to this country, and especially of all that are published by the authority of the States. I write to ask that you will furnish us with a set of all which have been issued by your State. Owing to the rapid development of our country, its maps are being changed constantly, and very soon after being issued often become of great historic value.

Many maps are issued by societies and private firms which are useful in tracing historic changes of names, etc., that appear on them; and I shall consider it a favor conferred if you will give us information as to any which may be of local value, so that we may take the proper steps to secure them.

Old maps are equally as important for our purpose as new ones. County maps as well as State maps will be desirable. We will gladly forward franked mailing slips for any which may be offered us. I inclose herewith a franked envelope for reply.

I am, very respectfully,

T. C. MENDENHALL,
Superintendent.

In response to this circular answers from the executives of thirty-three States and Territories were received, viz: Alabama, Alaska, Arkansas, Arizona, California, Colorado, Delaware, Iowa, Louisiana, Maine, Michigan, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Virginia, Washington, West Virginia, and Wisconsin.

No answers were received from the following: Connecticut, Florida, Georgia, Idaho, Illinois, Indiana, Indian Territory, Kansas, Kentucky, Maryland, Massachusetts, Minnesota, New Mexico, Oregon, Utah, Vermont, and Wyoming.

The information received was very meager. Eight States and Territories replied that they have no officially authorized maps, viz: Arizona, Delaware, Iowa, Louisiana, Montana, Nevada, Oklahoma, Texas, West Virginia, and Alaska.

Ten States sent small railroad maps, of various scales, issued by the State railroad commissioners, and of but little geographical value, viz: Alabama, Arkansas, Maine, Michigan, Missouri, Nebraska, North Dakota, Ohio, Pennsylvania, and Virginia.

California sent two geological maps. Mississippi states that their State map was issued in 1873 and 1882, that the editions are both exhausted, and that they are unable to furnish a copy of either. Nebraska sends a statistical map. New Jersey sent their Geological Survey Atlas, by Cook. New York refers us to the State engineers, and to the New York State and Adirondack surveys, which we already have. Ohio sent a small map with geological features superimposed, saying that the value is only that of the original map, which is in doubt. Rhode Island and South Carolina promised to comply soon, but we have not heard more from them. Several of the Territories refer us to the reports of the Secretary of the Interior.

The reading room has, during the past year, shown its value by the number of persons who have made use of it, consulting the periodicals and other works which refer to the branches of science upon which they are employed. This was especially noticeable during the winter months, when a large proportion of our field men were in the city. During the Geodetic Conference the resources of the library were largely drawn upon by the members of that body; and much gratification has been expressed at the progress already made in our collections, and many valuable suggestions have been made by those who are engaged in research.

I desire to express my appreciation of the uniform courtesy and assistance which has been shown me by officers and employees with whom I have had official dealings in conducting this Division.

Respectfully, yours,

FRANCIS H. PARSONS,
Chief of Library and Archives Division.

Mr. B. A. COLONNA,
Assistant in charge of the Office.

SUPPLEMENT TO REPORT OF LIBRARY AND ARCHIVES DIVISION.

Working force of Division 1893–'94.

Name.	Period.	Number of working days.	Absent: Sickness, leave, or other causes.	On duty.
F. H. Parsons	Whole year	304	22½	282¼
A. Martin	do	304	24½	279¾
John Dale	do	304	25	279¼
W. P. Mangum	December 1, 1893 to March 11, 1894	83	11½	71½
Totals		995	83½	912¾

Records received in the Archives during the year ending June 30, 1894.

	Observations.		Computations.		Remarks.
	Original.	Duplicate.	Field.	Office.	
Horizontal measures	127 vols	128 vols	92 cahiers	24 cahiers	
Vertical measures	22 vols	20 vols	12 cahiers	1 cahier	
Base measures	11 vols	12 vols	21 cahiers	1 cahier	2 pkgs. zinc plates.
Geodetic miscellany	9 vols				
Geodetic miscellany	1 cahier				
Description stations	15 vols	12 vols			
Description stations	17 cahiers	14 cahiers			
Level observations and notes	48 vols	27 vols	5 cahiers	1 cahier	
Level observations and notes	3 cahiers	1 cahier			
Level observations and notes	3 sheets				
Magnetic traces, etc	65 cahiers	38 cahiers	1 cahier		
Magnetic traces, etc	180 sheets	329 sheets	197 sheets		
Magnetic traces, etc	6 vols	3 vols	4 cahiers		
Astronomical time	27 vols	38 vols	4 vols	19 cahiers	
Astronomical time	1 cahier		4 cahiers		Chronograph sheets.
Astronomical time	49 (C. S.)*				
Astronomical latitude	23 vols	14 vols	26 cahiers	38 cahiers	
Astronomical latitude	2 cahiers	1 cahier			
Astronomical azimuth	11 vols	11 vols	9 cahiers	3 cahiers	
Astronomical azimuth	1 cahier	1 cahier			
Pendulum gravity	12 vols	11 vols	5 cahiers		
Pendulum gravity	22 (C. S.)				
Photographic	205 negatives			1 482 prints	
Photographic	14 boxes negatives			44 lant'rn slides	
Topographic reconnaissance	5 vols	1 vol			
Soundings	217 vols	168 vols			
Hydrographic angles	24 vols	26 vols			
Tides	70 vols	53 vols			
Tides	4 cahiers	2 cahiers			
Tides	7 sheets				
Tides maregrams	104 rolls	224 sheets			
Tides maregrams	2 520 sheets				
Log books	60 vols				
Descriptive report topographic sheet	5 cahiers				
Descriptive report hydrographic sheet	14 cahiers				
Currents, densities, etc	2 vols	1 vol			
Currents, densities, etc	1 cahier				
Character of bottom	4 vols	5 vols			
Character of bottom, specimens	127 bottles				
Meteorological	1 vol				
Reports of chiefs of divisions	1 pkg				
Topographic sheets	44 pkgs				
Hydrographic sheets	30 pkgs				

OFFICE REPORT No. 2.

REPORT OF THE HYDROGRAPHIC INSPECTOR FOR THE FISCAL YEAR 1894.

United States Coast and Geodetic Survey,
Office of the Hydrographic Inspector,
Washington, D. C., November 1, 1894.

Sir: I beg leave to submit the following report of the hydrographic operations under this office, including the movements of the vessels of the Survey and the reports of the Chiefs of the Hydrographic and Coast Pilot Divisions, for the year ending June 30, 1894. I beg also to append a roster of officers of the Navy who have been connected with the Survey during the fiscal year.

HYDROGRAPHY—ATLANTIC COAST.

The beginning of the fiscal year found the schooner *Eagre* and party, under the command of Lieut. W. F. Low, U. S. N., Assistant, actively engaged in the resurvey of Boston Harbor and Bay, having taken the field on the 9th of May. At the close of the season, November 29, 1893, four sheets on scale 1–10 000 were finished, and this practically completed the hydrographic resurvey of these waters.

The area covered during the season of 1893 consisted principally of that portion of Boston Harbor lying to the southward of a line drawn from Windmill Point (Nantasket) to Long Island Lighthouse and South Boston. It included Hingham Bay and Harbor, Quincy Bay, Neponsett River, Weymouth Fore and Back rivers. An outside sheet covered the approaches from Cohasset Harbor to Point Allerton.

The season of 1894 opened on April 17, and the work to the end of the fiscal year consisted mainly in a more minute development of certain features in the hydrography of 1892 and 1893, and in special examinations of numerous rocks and ledges not heretofore found. Several new discoveries were made, and the nonexistence of a number of shoal spots, indicated on the present issues of our charts, was proved. The search made for these shoals was most thorough, repeated dragging being one of the methods employed, and leaves no doubt as to their nonexistence.

Special acknowledgment is due Lieutenant Low for the thorough execution of the work, particularly for the comprehensive manner in which he obtained the data for the tidal establishment over the different areas under his charge. By series of long observations at various gauges and very complete comparative observations at fourteen auxiliary gauges a plane of reference was obtained that left nothing to be desired, and caused the soundings to cross with great accuracy.

The steamer *Bache* continued under the command of Lieut. R. G. Peck, U. S. N., Assistant. Extensive repairs of the hull were commenced on March 23, 1893, and were completed in the following December, when she went to Baltimore. New motive power was introduced and many repairs were made on the hull, including a large amount of rebolting, to all of which reference will be made under head of "Repairs."

The *Bache* left Baltimore January 20 for Charleston, South Carolina, where a survey of the Ashley, Cooper, and Wando rivers was made between January 30 and May 8. On the arrival of the *Bache* at Charleston, January 24, Messrs. John W. Donn and C. H. Boyd, Assistants, reported on board and were assigned quarters. Owing to the marsh belt bordering the rivers, it was deemed advisable to carry on the topography from the river edge of the marsh to the fast land from the vessel. using the hydrographic party to assist in the work and in the erection of signals. This arrangement was successfully carried out until May 6 when, the topography of the shore line being finished, the chiefs of the topographical parties took up quarters on shore.

The locality and general extent of the work assigned to the party under the charge of Lieutenant Peck embraced, exclusive of the numerous creeks within its limits, about 12 miles of the Ashley, 8 miles of the Cooper, and 4 miles of the Wando River, this being the limit of the triangulation and topography. Four projections were used to cover the ground, the party completing the hydrography to the limit.

Until March 6 the entire force of the vessel was employed in the erection and location of signals and the survey of the shore line and marsh border.

In the execution of the hydrography, one system of lines was carried perpendicular to the axis of the stream (normals), and this system was intersected at right angles by a second system (longitudinals), following the general direction of the river. The normals were spaced at intervals of 50 to 150 metres, and the longitudinals at varying intervals, the system being modified by the irregular widths of the stream. The cases of special development were most frequent in the Ashley, where, as Lieutenant Peck reports, "owing to the washings from the works where phosphate rock is crushed and washed, the shoals are constantly increasing in extent, and the depth of water steadily diminishing. In this manner the navigation of the river has already become considerably obstructed; and should these injurious operations continue, it would seem to be only a question of time when the Ashley will cease to be a navigable stream."

Lieutenant Peck successfully completed all work assigned to him by May 8. His sheets, records, and all details connected with the survey may well serve as models of excellence and perfection. Lieutenant Peck is a careful and painstaking officer, and his work is most thorough in every respect. The reports give full detailed information regarding the geography, navigation, and traffic of these rivers, and I desire particularly to call your attention to them, as they treat exhaustively of the locality. They urge a continuation of the survey within certain limits. Lieutenant Peck notes very considerable changes in the shore line of Morris Island, and makes a number of recommendations affecting the present condition of our charts of Charleston Entrance.

The *Bache* reached New York on May 12, where she refitted for work on the eastern coast.

The steamer *Blake*, Lieut. G. W. Mentz, U. S. N., commanding, Assistant, continued as an exhibit of the Survey at the World's Columbian Exposition until October 5, 1893, when she left the Fair Grounds and went to Chicago to prepare for her return to the Atlantic Coast.

This vessel sailed from Chicago October 15, and arrived at Baltimore, Maryland, November 24, having called at St. Andrews, New Brunswick, to carry three boats to the schooner *Eagre*, at Boston, Massachusetts. On the passage from Boston to New York the *Blake's* party determined the position of eleven light vessels in Nantucket, Vineyard, and Long Island sounds, and the entrance to New York Lower Bay.

After undergoing necessary repairs, the *Blake* started from Baltimore for Pensacola, Florida, on January 20, 1894, in company with the steamer *Bache*, to Charleston, South Carolina, and stopped at the following places: St. Lucie Inlet, Florida, to make an examination of a new opening through the beach at that point; at Key West to obtain tracings showing improvements of the channels by the Corps of Engineers, U. S. Army; at Punta Rasa to receive a naphtha launch, and at Tampa Bay Entrance to locate Palatine Shoal. The party arrived at Pensacola February 6.

A series of eight projections had been laid out to cover a complete resurvey of Pensacola Bay, including Escambia Bay, East Bay, East River, and Big Lagoon. Three projections extending over Pensacola Bay proper were assigned to the *Blake's* party, the other five to Lieut. F. Swift, U. S. N., Assistant, who with Ensign C. M. McCormick, on the arrival of the *Blake* at Pensacola, organized a hydrographic party on board the schooner *Transit.*

The *Blake's* party began work immediately on projection No. 3, comprising the central part of the bay, from Bayou Texar to the village of Woolsey and across to Town Point and Santa Rosa Island. All sounding work was done in pulling boats, and the sheets finished at the close of the season, May 11. The lines were run 150 metres apart, normal to the general shore line, and this system was intersected by a second series of lines about the same distance apart, at right angles to the first system. At the docks of Pensacola the lines were run 75 metres apart and the shoal off Town Point was specially developed, as was also the channel leading to Muscogee Wharf.

Between April 17 and 29 the party was engaged in searching for a reported 10-fathom bank off the South Pass, Mississippi River. The shoal was not found, but indications of a bank, with a least depth of 52 fathoms, outside the 100-fathom curve were discovered. This bank will be made the subject of another examination.

On May 14 the *Blake* started for Tampa Bay to determine the position of Palatine Shoal, and to send Lieut. C. S. Ripley, U. S. N., overland to St. Lucie Inlet to make an additional examination at that point.

The location of Palatine Shoal was finished May 21, and the *Blake* started for New York, stopping off St. Lucie Inlet to pick up Lieutenant Ripley who had, in the meantime, completed the reconnaissance of the inlet.

The *Blake* arrived at New York May 29, and made preparations for work on the eastern coast.

The hydrographic party on board the schooner *Transit* was organized by Lieut. F. Swift, U. S. N., Assistant, and began work on February 12, 1894. Three projections were completed, namely : The Big Lagoon, East River, and Escambia Bay ; the two former are the first surveys of the localities.

Big Lagoon is about 6 miles long by 1½ miles wide, and extends from just inside the entrance to Pensacola Bay westward to within ¾ mile of Perdido Bay. The entrance is shoal, there being a little more than 2 feet at M. L. W. in the main channel. Inside, the lagoon deepens to 3 fathoms, which can be carried about three-quarters its length. At the head of the lagoon the water shoals, but good water can be carried as far as the ditch which is cut through to Perdido Bay. The shore line was found very much changed from that of the old survey.

The work in Escambia Bay extended from the L. & N. R. R. bridge to a line drawn from Garcon Point to Emanuel Point. In general, more water was found than was shown on the old survey, this being especially true of the water on the oyster reefs.

East River, at the extremity of East Bay, is 3 miles long by ¾ mile wide. It is a fine body of water without shoals and is easily entered. The hydrography was extended into East Bay.

The naphtha launch attached to the *Transit* was a valuable adjunct. It is Lieutenant Swift's opinion that this type of launch, when once thoroughly understood, is as well, if not better suited to hydrographic work than any steam launch. The parts are simple and retain their, adjustment; it is easily operated and not very expensive.

In sounding, a pole was always used up to depths of 16 feet. In soft mud, owing to the disk on the end, correct soundings could be obtained where a lead was misleading on account of its sinking into the mud.

The party was disbanded and the *Transit* laid up May 1, the officers returning to the *Blake* and resuming their duties on board that vessel.

The work of this little party is excellent in many respects and deserves commendation. Lieutenant Swift has served on board the vessels of the survey for a number of years, this his second tour of duty, and I cheerfully testify to his ability as a commanding officer and hydrographer.

The steamer *Endeavor*, having on board the party under the charge of Lieut. E. H. Tillman, U. S. N., Assistant, after having towed steam launch No. 23 from Hull, Massachusetts, to

Eastport, Maine, was temporarily employed under the Superintendent's personal direction in running ranges, building signals, etc., for use in determining and marking the "Water Boundary" between the United States and Canada.

On the passage to and from Eastport the party made special hydrographic examinations in seven different localities along the coast of Maine. After refitting at Boston, the *Endeavor* proceeded to Long Island Sound where special examinations were made in numerous localities between Hammonassett Point, Connecticut., and Rye Neck, New York.

This work was closed on September 11 and the Coast Pilot work commenced. This consisted in verifying sailing lines and collecting general and special information for a Coast Pilot volume to cover the coast between Coney Island, New York, and Cape Charles, Virginia. Incidental to the work, Northeast End Five Fathom Bank, Five Fathom Bank and Winter Quarter light vessels were accurately located.

The *Endeavor* arrived at Baltimore on October 2, and October 5 Lieutenant Tillman was relieved of the command by Lieut. L. M. Garret, U. S. N., Assistant, who at once began preparing the vessel for work on the southern coast. Lieutenant Tillman resumed his duties in this office as Chief of the Coast Pilot Division.

Pursuant to instructions Lieutenant Garret and party left Baltimore on January 5, 1894, for Brunswick, Georgia, to make a detailed survey of the outer bar of the entrance to St. Simon Sound. After encountering many difficulties due to the loss or destruction of trigonometric stations, a sufficient number of points were established. Sounding was commenced on February 6, and finished March 20.

Two months' observations of tides resulted in a plane agreeing exactly with the six months' series of the Corps of Engineers, United States Army, both as to range and reference to the bench. An excellent series of comparative observations were made at a staff pumped in the sand near the crest of the outer bar, and the results were used in making time allowance in the reductions of soundings.

The results of this survey are highly satisfactory in every respect, and the accuracy and completeness of every detail are a credit to Lieutenant Garrett and his party.

From Brunswick Lieutenant Garrett sailed to Savannah River, Georgia., where he at once proceeded to carefully locate all light-houses, beacons, jetties, etc., correcting errors in existing charts and determining the advisability of a resurvey of Tybee Roads and Bar. This work occupied the party until April 13.

The Light-House Board having requested a careful survey of the Outer Shoals, Cape Hatteras, North Carolina, Lieutenant Garrett was instructed to carry out the work. The object of this survey was to determine a location for an apparatus by means of which borings might be obtained and the nature of the strata determined and studied in connection with the question of erecting a light structure on the shoals.

The party arrived in the field April 18, and in spite of the obstacles and the various delays due to the extremely unfavorable conditions, the party finished the survey May 12. On the 16th the inspector of the district, Capt. Yates Sterling, U. S. N., arrived off Hatteras, and, after consultation with Lieutenant Garrett, the position for the boring apparatus was buoyed. The work for this party being finished, the *Endeavor* returned to Baltimore to refit for the summer work.

It is my opinion that this survey of the Outer Shoals is the most accurate that has yet been made. The care and precision of not only this work, but all work conducted by Lieutenant Garrett, deserves the highest commendation.

Hydrographic work was also executed by Assistant S. Forney on Cheputneticook Lake and the southern part of Grand Lake, New Brunswick and Maine, and by Assistant H. L. Marindin off the north shore of Nantucket, Massachusetts.

HYDROGRAPHY—PACIFIC COAST.

The steamer *Patterson*, under the command of Lieut. Commander W. I. Moore, U. S. N., Assistant, having left San Francisco on April 13, 1893, was at the beginning of the fiscal year actively engaged in a survey of Sitka Harbor and approaches, Southeast Alaska.

The work, as is usual with this party, comprised astronomical observations, measurement of base line, triangulation, topography, and hydrography, including very complete tidal and occasional current observations. Owing to the great irregularities in soundings on the inshore hydrography, it was found necessary to run the lines of soundings at very short intervals, while special developments were made wherever necessary.

The results from this survey are satisfactory, and consist of numerous records of the work, including three topographic and four hydrographic sheets. The photographic work of the season was unsuccessful, owing to the inferior quality of plates.

During the latter part of the season a boathouse, with launch ways, was built for the *Cosmos* on Japonski Island.

On September 1 the *Patterson* left Sitka, and, after picking up at various places six civil parties engaged in the boundary survey, and landing two of them at Port Townsend, arrived at San Francisco on September 18, 1893.

The Navy Department, having requested the measuring of a 3-mile extension to the Santa Barbara speed-trial course, laid out in 1890, Lieut. Commander Moore was instructed to proceed to the locality and execute this work.

The *Patterson* arrived at Santa Barbara on October 25, and began to rebuild the old signals and to construct and determine new range signals. The course of 1890, over which the U. S. S. *San Francisco* was tried, measured 39·98327 nautical miles; the extension laid out by Lieut. Commander Moore is 2·99846 nautical miles, making the length of the new course 42·98173 nautical miles.

The *Patterson*, after taking part in the speed trial of the *Olympia*, which was successfully accomplished on December 15, returned to Mare Island Navy Yard on December 20.

Until April 4, 1894, the party was engaged in office work, repairs of the vessel, and in experiments with wire for use in the measurement of base lines. After fitting out in San Francisco, and receiving on board Assistant Morse and Messrs. Edmunds and Taylor, with some field hands of the Alaska boundary party with their equipment, she sailed April 21 and anchored at Port Townsend April 25. Here she received on board for transportation to Alaska Assistants McGrath and Dickins and Mr. Tinsley and parties, also of the boundary survey.

The *Patterson* left Port Townsend April 28, towing the *Earnest* and in company with the *Hassler*, for Departure Bay, when, after coaling all the vessels, they proceeded to Alaska. On May 3 the *Patterson* and *Earnest* grounded on the southern end of Warke Island, but came off on the following high water without serious damage and continued the voyage. After landing Assistant Dickins and Mr. Tinsley and party at Burroughs Bay, and transferring the schooner *Earnest* to the *Hassler* at Juneau, she proceeded to Sitka, arriving there May 12. On May 20 she left Sitka for Yakutat Bay, and after landing Assistant McGrath and Mr. Edmunds and party near Point Manby on the 22d, returned the following day to Sitka, and then sailed for the working ground near the north end of Chatham Strait.

At the close of the fiscal year the work of the season was well under way, the measurement of the primary base (1 950·58 metres long) with steel tape, was completed, the signals built, and the triangulation, topography, and hydrography were progressing satisfactorily. The astronomical work was retarded on account of cloudy and foggy weather.

The steamer *Hassler*, Lieut. G. B. Harber, U. S. N., Assistant, commanding, has been employed in connection with the Boundary Survey in carrying chronometer comparisons between the field parties at Sitka. During July and August, 1893, she made four trips for exchange of errors between Sitka and the observatories at the head of Taku Inlet, at Wrangell and at Burroughs Bay.

On the first trip in July the *Hassler* transported Assistant McGrath, with his party and outfit, from Taku Inlet to Wrangell, and on the second trip in same month transferred Assistant Ogden with his party from Taku Inlet to Wrangell. During the first trip in August a reef to the south of Annette Island, and another in Kasaan Bay, were located.

In company with the *Patterson* and *Earnest*, the *Hassler* returned to Puget Sound, arriving at Tacoma September 26, where she was moored for the winter.

On April 27, 1894, at Tacoma, the vessel received on board the officers and men of several of the Boundary Survey parties with all their camp outfit, instruments, stores, etc., and joining the *Patterson* at Port Townsend, sailed for Pyramid Harbor, Southeast Alaska, stopping en route at Port Simpson for the steam launch *Fuca*, at Wrangell for boats and lumber, and at Juneau for a member of the Canadian surveying party.

She arrived at Pyramid Harbor May 12, landed the civil parties, and on May 16, observations having been obtained at the shore observatory, she sailed for Sitka, and returned to Pyramid Harbor on May 22, thus completing one round trip of chronometer exchange. During the month of June she made two more trips between these same points, and went to Loring for Assistant Dickins's party, landing them at Pyramid Harbor June 18.

During and between these runs the party on board the *Hassler* was engaged in sketching in the topographical features that have been omitted on certain of our charts, and that, it was thought, might be of service to the mariner. At the end of the fiscal year the area covered consisted of 225 square miles.

I beg in this connection to call your attention to the excellent work of this party in connection with the Boundary Survey, and the intelligent and thorough manner in which the topographical sketching was done. It is true that the first-mentioned work consisted in simply making the runs from one station to another, yet in a country where fog, rain, and gales of wind are the rule, where much of the route lies along a rocky, uncharted region, it requires navigation of a high order, which was displayed with skill by the commanding officer, Lieutenant Harber.

Lieut. F. H. Crosby, U. S. N., Assistant, assumed command of the steamer *McArthur* on June 20, 1893. This vessel had previously been disabled by losing her propeller at sea, and as no money was available to replace it, the vessel was detained. Soon after the appropriation of 1894 became available the vessel was put under repairs and made serviceable for work.

Pursuant to a request from the Navy Department the *McArthur* was directed November 1, to proceed to Santa Barbara to take part in the speed trial of the *Olympia*. While on the coast of southern California Lieutenant Crosby was instructed to make certain investigations and hydrographic examinations.

Between the trials of the *Olympia* the party went to San Pedro and obtained the latest survey of the harbor from the Corps of Engineers, United States Army, and investigated the physical and commercial features of that place. The new railroad wharf at Port Los Angeles was located, Lieutenant Crosby reporting that the name of "Port Los Angeles" covered nothing but the wharf, and that the name was recognized officially because it had been made a port of entry. Port Ballona exists in name only.

Redondo Beach wharf was located by the party.

The final speed trial of the *Olympia* took place on December 15, and the *McArthur* sailed for San Diego to make a hydrographic examination of the Middle Ground bar and of certain reported outlying dangers that had never been located. The results of this survey have been indicated on our charts; they show a depth of 23 feet over the bar, and the Middle Ground cut, dredged by the United States Engineers, filled in. New Hope Rock was located and was found nearly a mile farther south, and farther off shore, than reported. Lieutenant Crosby reports, "no one had any knowledge of a rock southwest of Point Loma Lighthouse near the position given for a dangerous rock, nor could I find any indication of it, except by one sounding which I think proved to be false, by about three hours' work around its position."

The *McArthur* reached San Francisco Harbor on January 10, 1894. While at San Francisco awaiting suitable weather for the continuation of the work on the coast of Washington, the party developed the inshore hydrography at the entrance to San Francisco Bay whenever the sea and weather would permit.

On April 4 the *McArthur* sailed for Gray's Harbor, Washington, arriving April 8. Preparations were immediately made to continue the coast hydrography from James Island, Washington, to the southward. Signals were built and determined and a tide gauge was established on Destruction Island.

This work is the most difficult and hazardous of any on the coast of the United States. The frequent and heavy gales of the North Pacific, with the attending tremendous seas, come home on these treacherous shores. Add to this, sudden and prolonged fogs and widely separated harbors, that can only be entered in good weather, and conditions will be presented which require judgment, nerve, and experience, not only as a hydrographer, but as a commanding officer. Lieutenant Crosby's long and successful experience on the survey as a subordinate, and as a chief of party, coupled with unusual skill and judgment in handling vessels, admirably fitted him for this service, and I felt in securing him for this work that the Survey had the very best material that could be obtained anywhere.

The progress of the party at the close of the fiscal year exceeded my highest expectation, 886 miles of lines having been executed.

During the working season from July 1 to October 10, 1893, the steamer *Gedney*, Lieut. Lucian Flynne, U. S. N., Assistant, commanding, and party, were engaged primarily in cooperating with Assistant J. J. Gilbert in the triangulation of the Straits of Juan de Fuca, and, at such times as a division of forces could be made, in continuing the hydrography in the strait between Pillar Rock and Cape Flattery. Two special examinations were made, one near Duncan Rock off Tatoosh Island, another off Middle Point, Admiralty Inlet.

At the conclusion of the work the vessel went to Seattle for the winter to repair and refit for the work of the following season.

The party left for the working ground, at the eastern end of the Strait of Juan de Fuca, on May 8, 1894, and was subsequently joined by Assistant Gilbert for combined operations in Washington Sound. Hydrography was carried on whenever circumstances would permit, and consisted in developing more closely the banks and shoals in the eastern part of the strait from Ediz Hook to Whidby Island. By June 30, 1894, an area of 214 geographical square miles had been covered.

It affords me pleasure to say that the work of this party in every way was performed with great satisfaction, and the good judgment and skill exercised by Lieutenant Flynne in managing the ship details of the combined party, and the harmony which exists in all the details calls for commendation.

Statement of Hydrographic Surveys executed during the fiscal year ending June 30, 1894.

Parties.		Localities.	Surveyed by—	Sheets.	Scale.	Number of—					Remarks.
Naval.	Civilian.					Vols.	Angles.	Soundings.	Miles.	Square miles.	
	1	Chipuneticook Lake and southern part of Grand Lake, New Brunswick, and Maine.	S. Forney	3	10 000	14	3 270	34 044	352	19	
1	----	Examination along coast of Maine (seven localities).	E. H. Tillman, U. S. N.	*	10 000	1	287	906	10	1	*Plotted on six different sheets.
2	---	Boston Harbor and Approaches	W. F. Low, U. S. N.	3	10 000	33	9 496	57 398	695	32	
2	----	Boston Harbor and Approaches (additional work for five sheets).	W. F. Low, U. S. N.	--------	10 000	16	4 268	15 560	225	5	
	2	Nantucket, north shore, Brant Point to Great Point.	H. L. Marindin	1	10 000	4	3 644	8 596	87	6	
1	----	Long Island Sound (additional work, Guilford to Port Chester).	E. H. Tillman, U. S. N.	*	10 000	10	3 077	15 146	127	4	*Plotted on 8 different sheets.
3	----	Search for reported shoals off coast of Maryland.	G. W. Mentz, U. S. N.	--------	80 000	1	--------	113	7	--------	
4	----	Outer Shoal, Cape Hatteras, North Carolina.	L. M. Garrett, U. S. N.	1	20 000	1	385	1 672	61	3	
5	----	Ashley, Cooper, and Wando rivers, North Carolina.	R. G. Peck, U. S. N.	4	10 000	23	7 129	31 095	305	11	
4	----	Test lines over Savannah River bar, and locating lights and buoys.	L. M. Garrett, U. S. N.	*	20 000	1	58	474	12	--------	*Soundings plotted on sheet 244.
4	----	Outer Bar, Entrance to St. Simons Sound, Georgia.	L. M. Garrett, U. S. N.	2	1-20 000 1-5 000	8	2 808	17 731	315	10	
3	----	St. Lucie Inlet, Indian River, Florida.	G. W. Mentz, U. S. N.	*	20 000	2	43	2 812	20	1	*Plotted on sheet 1571.
3	----	Search for shoal spot, off Entrance to Tampa Bay, Florida.	G. W. Mentz, U. S. N.	*	20 000	1	42	325	3	--------	*Plotted on sheet 1262.
3	----	Pensacola Bay, Florida, middle part.	G. W. Mentz, U. S. N.	1	10 000	20	5 884	47 975	499	25	
6	----	Escambia Bay, East River, and Big Lagoon (Pensacola Bay).	F. Swift, U. S. N.	3	10 000	36	7 935	73 285	685	25	
3	----	Search for reported 10-fathom bank off South Pass, Mississippi River.	G. W. Mentz, U. S. N.	*	80 000	1	12	424	261	25	*Plotted on chart 194.
7	----	Entrance to San Diego Bay, California.	F. H. Crosby, U. S. N.	1	10 000	2	755	1 814	63	2	
7	----	Coast of Washington, Grays Harbor to James Island.	F. H. Crosby, U. S. N.	1†	40 000	6†	3 600†	11 472	886	150†	† Estimated.
8	----	Strait of Fuca, western part	L. Flynne, U. S. N.	1	80 000	2	755	843	211	266	
8	----	Off Tatoosh Island and off Middle Point (additional work).	L. Flynne, U. S. N.	*	20 000	3	252	347	18	--------	*Plotted on sheets 1881 and 1516.
8	----	Strait of Fuca, eastern part	L. Flynne, U. S. N.	1	80 000	2†	1 433	600	325	214	† Estimated.
9	----	Sitka Harbor and Approaches, Alaska.	W. I. Moore, U. S. N.	4*	1-10 000 2-20 000 1-40 000	18	12 297	19 045	1 410	264	*Also three topographical sheets.
9	----	Chatham Strait, Alaska	W. I. Moore, U. S. N.	1	80 000	3†	1 815	2 820	364	157	† Estimated.
10	----	Southern Alaska, Chart 8300	G. B. Harber, U. S. N.	--------	----------	------	--------	--------	--------	-------	*629 square miles topographical reconnaissance.
10	2										
12		Grand total for the year ending June 30, 1894		27	----------	208	69 245	344 497	6 941	1 220	

Naval Party No. 1 determined the following light vessels: Northeast end of Five Fathom Bank, Five Fathom Bank and Winter Quarter Shoal. Also engaged in Coast Pilot work. Naval Party No. 3 determined the following light vessels: Pollock Rip, Shovelful Shoal, Handkerchief, Great Round Shoal, Cross Rip, Succonesset Shoal, Vineyard Sound (Sow and Pigs), Bartlett Reef, Sandy Hook, and Scotland. Naval Party No. 8 was primarily engaged in cooperating with Assistant Gilbert in the triangulation of Strait of Juan de Fuca. Naval Party No. 9 was engaged part of the time in transporting boundary survey parties; also measured eastern extension of 3 nautical miles to Santa Barbara Trial Course (for *Olympia's* trial). Naval Party No. 10 carried on topographical work during and between trips from Pyramid Harbor and Sitka, carrying chronometers; was also engaged in transporting United States and Canadian boundary survey parties.

Number of specimens of bottom, 77.

Current stations occupied by hydrographic parties, 70.

HYDROGRAPHIC DIVISION.

Lieut. Robt. T. Jasper, U. S. N., having been detached May 8, 1893, this Division was under my personal supervision until August 24, on which date Lieut. Walter McLean, U. S. N., Assistant, assumed charge, and under his able management continued the work on the general lines of his predecessor. This Division is in a high state of efficiency, and much credit is due the personnel for the excellent manner in which the work is carried out. I beg to invite your attention to the report of Lieutenant McLean, forwarded herewith, and relating to the work performed by the Division.

COAST PILOT DIVISION.

This Division was in charge of Lieut. E. H. Tillman, U. S. N., Assistant, until June 16, 1894, when he was detached by order of the Navy Department, his term of service on the Survey having expired.

The work of this Division is so well and favorably known to the office and the maritime public through its publications, that it is only necessary for me to refer to the report of Lieutenant Tillman, transmitted herewith.

A tide and current chart for Nantucket and Vineyard sounds was devised by Lieutenant Tillman and Mr. John Ross, which has been favorably criticised by seafaring men who have used it.

I beg, in this connection, to express my appreciation of the services of Lieutenant Tillman whilst in charge of this Division. The interest manifested in the work, and the skill and ability exercised in every detail, merits special notice.

Lieut. Commander S. M. Ackley, U. S. N., the Hydrographic Inspector, being absent in Alaska, I continued as acting Hydrographic Inspector until October 30, 1893, when Lieut. Commander Ackley was detached from the Survey and ordered to command the U. S. S. *Yantic*, and I succeeded him as Hydrographic Inspector.

It is my painful duty to note the death of Lieut. Chas. F. Emmerich, U. S. N., Assistant. This officer, after serving as executive of the *Hassler* during the spring and summer of 1893, in Alaska, in obedience to instructions from this office, reported on board the *McArthur* December 4, 1893, at San Pedro, California, for the command of that vessel, but being ill he did not assume command. Soon after the return of the *McArthur*, January 11, 1894, to San Francisco, Lieutenant Emmerich was carried to the Naval Hospital at Mare Island, January 26, where he died February 4, 1894. Lieutenant Emmerich was an officer of ability, and he gave great promise of becoming a successful chief of party.

REPAIRS AND MAINTENANCE OF VESSELS.

ATLANTIC COAST.

The steamer *Bache* was thoroughly overhauled and repaired at the works of Messrs. Brown & Miller, Jersey City, New Jersey, this firm having been awarded the contract for new motive power.

The *Bache* is an iron vessel, built in 1871, sheathed with wood in 1880, and rebolted in 1890.

In removing the old engine and boiler the frames and floors were found in very bad condition, and the iron plating of the skin entirely gone in several places. Angle irons were bolted to the frames, and the wood sheathing bolted through the angles; the keel bolts were renewed as well as the defective bolts under the water tanks, and the floors and bulkheads either renewed or thoroughly repaired. Besides the new engine and boiler and the above-mentioned repairs, the main and spar decks were thoroughly overhauled or renewed, calked, and the spar deck re-covered. Several spar-deck beams were replaced and secured with hanging knees, and new steel deck beams were secured over the boiler. The following were renewed: Main topmast, trestle tree, jib boom, main-deck port shutters, catheads, head rail, waterways forward, water tanks, fire-room floor plates, wood floor in coal bunkers, ventilators for boiler room, exhaust pipe, pilot house, propeller, etc. In December the repairs were finished and the vessel proceeded to her working ground on the coast of South Carolina. In June a new propeller shaft, full length, was supplied. It is my belief that the vessel will now be serviceable for at least ten years, with the usual small repairs each year.

Blake.—The boilers of the *Blake* were retubed at Baltimore. She was docked, and the holding-down bolts renewed and mooring bits replaced. Other minor repairs were made to boilers, engine, rigging, and hull. This vessel was built in 1874 and is in good condition, considering her age. Her crank shaft is out of line, and the main-engine cylinder should be rebored and lined up. She will probably be given a general overhauling very soon.

Endeavor.—This vessel is more than thirty years old and is in very good condition. She received during the year new steam reversing gear, engine-room keelsons, shoe, rudder and rudder post, and some minor repairs to galley, closets, hull, and machinery.

The schooners *Eagre*, *Quick*, *Transit*, and *Spy* received a number of small repairs. The decks of the *Eagre* were calked. It will probably be necessary in the near future to give this vessel an extensive overhauling.

The *Quick* is a composite vessel built in 1873, and has never had extensive repairs. Her top sides are badly decayed and the bolts and frames very much corroded. Unless she is generally repaired, which may amount to practically rebuilding her, she can not be serviceable much longer.

PACIFIC COAST.

Patterson.—Repairs were made to this vessel as follows: Hawse pipe, main deck, rudder, jib boom, steering-screw gear, closets, galley, engine, piping, connections, etc. The electric-bell circuits were renewed and the cabin upholstered. The boats were thoroughly overhauled, and a new hull for steam cutter, a whaleboat, and dinghy supplied.

The boiler and decks of the vessel are in bad condition, and unless renewed the vessel must soon be laid up, as she will be unable to keep the sea.

I have asked for a separate appropriation for repairing the *Patterson*, as the small amount now allowed will not permit new boilers and decks for the vessel and at the same time maintain the other vessels of the Survey.

Hassler.—This vessel was docked and painted and fitted with radiators for heating. Repairs were made to engine, boiler, pumps, skylights, deck, galley, etc.

This vessel was built in 1872, of iron; her hull in places, particularly under the machinery space, is badly corroded, and she has been pronounced unsafe for outside work. I do not consider it for the best interests of the Government to make any extensive repairs on her.

McArthur.—As soon as the appropriation became available this vessel was supplied with a new composition propeller and propeller shaft, eccentrics and straps, feed pipes, steel piston rings, crank pin and brasses, braces for thrust bearing, windlass shaft, stand for sounding machine, lining for stern bearing, and closets for cabin. The following were repaired: Pumps, safety valve, rudder support, windlass valve gear, boat davits, closets, metal, and galley. The cabin transoms were upholstered, the main deck calked, and the vessel painted throughout. The *McArthur* is in good condition, but will require new metal sheathing, and new canvas on her spar deck.

Gedney.—This vessel had repairs made to engine, boiler, windlass, pumps, deck house, boats, davits, etc. She is in good condition, but will probably need overhauling in the near future.

The *Cosmos*, *Fuca*, and Atlantic coast launches received some minor repairs.

Steam launches for the *Bache*, *Blake*, *Endeavor*, and *McArthur* were contracted for, but not finished at the end of the year.

The schooner *Yukon* and launch *Helen*, being no longer required, were sold at Tacoma, Washington, at public auction.

REMARKS.

With the exception of the *Patterson*, built in 1884, all the vessels of the survey are old, and will require a larger expenditure for repairs in the future.

I beg in this connection to invite your attention to the condition of our work and the vessels on the Pacific coast. We have, as yet, made no surveys in Western Alaska and the Aleutian Islands, and as there is a growing demand for this work, it is, in my opinion, imperative that it should be commenced. The *McArthur* and *Gedney* are not suitable to encounter the boisterous weather of that region ; the *Hassler*, now condemned for outside work, will no doubt soon disappear from our list, and there remains the *Patterson* only for this service. This vessel, however, is now engaged on the surveys of Southeast Alaska, where she will be employed for some years. It is, therefore, in my opinion, necessary to ask Congress for an appropriation to build a vessel for this service. This vessel should be built of wood or steel, with a cellular bottom, and large enough to keep the sea in any weather if necessary. She should be built with a view to carrying large quantities of coal and stores of all kinds. A vessel able to do the work required would cost $125 000.

I would also recommend that some steps be taken to explore the delta of the Yukon, and the channels leading from the sea into that river.

I can not too strongly urge the necessity for an extended system of current observations. In many localities a knowledge of the current is of greater importance to the seaman than a knowledge of the tides.

We have many observations over different portions of the coast, but, as a rule, they were made by hydrographic parties merely incidental to the work. Current observations for use in predictions, must be made systematically and with the same care as tidal observations, and I beg to recommend that Congress be asked to appropriate a sufficient amount to commence this important work.

Mr. J. H. Roeth has satisfactorily performed the clerical duties under this office.

Very respectfully,

JEFF. F. MOSER,
Lieutenant Commander, U. S. N.,
Hydrographic Inspector Coast and Geodetic Survey.

The SUPERINTENDENT,
U. S. Coast and Geodetic Survey,
Washington, D. C.

REPORT OF THE HYDROGRAPHIC DIVISION FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

UNITED STATES COAST AND GEODETIC SURVEY,
Washington, D. C., October 13, 1894.

SIR: I have the honor to submit the following report of the work done by the Hydrographic Division during the fiscal year ending June 30, 1894.

I assumed charge of the Division on August 24, 1893, and during the year have followed, very generally, the methods of my predecessor in the conduct of the work of the Division, which has remained, in nature and scope, what it has been for some years past.

The permanent force at work in the Division during the year has consisted of Messrs. W. C. Willenbucher and F. C. Donn, draughtsmen, and Mr. E. H. Wyvill, chart corrector. The duties of these gentlemen have been performed in a most satisfactory and efficient manner and the zeal and faithfulness of each calls for my commendation. By their industry and attention to their duties these gentlemen have at all times kept the work of the Division well in hand and up to date. To Mr. Willenbucher is due especial credit for the energy and promptness with which he has performed the multifarious duties that devolved upon him as chief draughtsman of the Division. Mr. Wyvill has performed his multiplicity of duties as draughtsman and clerk in the office of the Division most satisfactorily, and I beg to earnestly renew the recommendation of my predecessor concerning his reclassification and advancement.

Mr. F. W. Clay received a probationary appointment as draughtsman and was assigned to this Division on November 29, 1893. From January 1 to June 1, 1894, Mr. Clay was attached as draughtsman to a hydrographic party in the field, an experience that has been of much practical value in enabling Mr. Clay to adapt himself to his duties in the Division with commendable efficiency. During the year Mr. Clay's work in the Division has been of a minor nature, but has been performed very satisfactorily.

Information received from the Unite States Engineers concerning the improvements in progress under their supervision has proved of great value in the preparation of charts issued by this Office, and I would urge that efforts be continued to have such information furnished with promptness and without specific request.

During the year 40 original hydrographic sheets, involving 67 540 angles and 333 559 soundings, have been plotted and drawn; 70 drawings of hydrography and 42 proofs of new issues of charts have been revised, verified, and corrected, and aids to navigation have been plotted on, or titles and notes have been supplied for, 148 new issues of charts.

The work of the Division has further included a large amount of miscellaneous drafting, the investigation and disposal of constantly received information from all sources concerning changes and corrections needed on the charts; the preparation and supervision of the publication of the monthly Notice to Mariners; and a considerable amount of general and routine correspondence and other miscellaneous work. For a more detailed statement of the work performed by the employees of the Division, I refer you to the monthly statements submitted during the year.

Very respectfully,

WALTER MCLEAN,
Lieut. U. S. Navy,
Chief of Hydrographic Division.

Lieut. Comdr. JEFF. F. MOSER,
U. S. Navy,
Hydrographic Inspector Coast and Geodetic Survey.
Washington, D. C.

REPORT OF THE COAST PILOT DIVISION FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

UNITED STATES COAST AND GEODETIC SURVEY,
Washington, D. C., June , 1894.

SIR: I have the honor to submit the following report of the work of the Coast Pilot Division for the fiscal year ending June 30, 1894:

Under the general direction of the Superintendent and supervision of the Hydrographic Inspector, the duties of this Division involve the execution of work both at the office and in the field.

At the beginning of the fiscal year I was in command of the Coast Survey steamer *Endeavor*, and with my party, consisting of Mr. John Ross, compiler in the Coast Pilot Division, and Mr. C Lee Green, pay yeoman of the *Endeavor*, was engaged in making special hydrographic examinations along the north shore of Long Island Sound. Work in this locality was closed on September 9, 1893, and the Coast Pilot work of verifying the data and sailing lines for a Coast Pilot volume to cover the coast from New York to Chesapeake Bay entrance was begun. This work was finished October 1, when I proceeded to Baltimore, where I was relieved, October 5, of the command of the *Endeavor* by Lieut. L. M. Garrett, U. S. N. Upon being detached from the vessel, October 10th and 31st, respectively, Mr. Ross and myself returned to the Office. My report to the Superintendent, dated October 23, 1893, gives the details of the work executed while afloat.

On July 12 the last proofs of "United States Coast Pilot, Atlantic Coast, Part III—From Cape Ann to Point Judith," were returned to the printer and the bound volume was ready for issue on September 30.

After returning to the office in October, the preparation of manuscript for "United States Coast Pilot, Atlantic Coast, Part V—From New York to Chesapeake Bay Entrance," was continued, and on December 18, completed and sent to the printer. The last proofs of this volume were returned to the printer on March 10, 1894, and the bound volumes received by the Office for issue, April 28, following.

From December 18, 1893, to March 10, 1894, when not occupied in reading and correcting proofs, and from the latter date until the end of the fiscal year, the Division was engaged mainly in the preparation of manuscript for a volume to be entitled "United States Coast Pilot, Atlantic Coast, Part VII—From Chesapeake Bay Entrance to Key West," and which, when issued, will complete the series covering the coast from Eastport, Maine, to Key West, Florida. A greater part of the manuscript for the volume has been prepared and put in shape, but a considerable amount of labor is yet necessary before it will be ready to send to the printer.

In addition to other office work of the Division, United States Coast Pilots, Atlantic Coast, Parts I, II, III, IV, V, and VI are corrected to date of issue, for all important information, affecting them, received at this office. In this connection I recommend that in future the edition of any of the Coast Pilot volumes be limited to six hundred (600) copies. The frequent changes in aids to navigation, depth on bars and in channels, etc., make necessary corrections to Coast Pilot volumes and accumulate very rapidly, and these corrections become so numerous for volumes that have been in print three or four years or longer that they can not be made without much labor, and without detracting to a considerable extent from the appearance and usefulness of the volume. The labor of correcting a large number of volumes which have been in print a number of years is as great as the labor of preparing a new edition, and the cost of a new edition is comparatively little.

In connection with the work of the Division a new method for graphically delineating information relating to tides and currents along continuous bodies of water, was devised by Mr. John Ross and myself, and upon this method a tide and current chart of Nantucket and Vineyard sounds was prepared and submitted to the Office for publication. An edition of three hundred (300) copies of the chart was printed, and nearly one-half of them distributed for trial, criticism, and suggestions, among those whom it was thought might be interested in the matter. Letters have been received from a number of persons to whom the chart was sent, and the opinions expressed have been unanimous in commendation of the method and the chart itself has been highly praised by those most familiar with the waters covered. It has been suggested that a chart of this kind covering Long Island Sound and East River would be invaluable.

A considerable amount of routine work has been performed in keeping a record of changes, reported dangers, hydrographic examinations, new information available, etc., up to date.

Mr. John Ross was employed in the Division as a compiler during the entire fiscal year, and it is a pleasure as well as a duty for me to testify to the valuable services he has rendered in the work both ashore and afloat.

Mr. Talbot Pulizzi has been employed during the entire fiscal year in copying manuscript, entering corrections in Coast Pilot volumes, and in posting the files of the Division, and has given satisfaction.

Very respectfully,
E. H. TILLMAN,
Lieut., U. S. N.,
Assistant Coast and Geodetic Survey.

Lieut. Comdr. JEFF. F. MOSER,
U. S. Navy,
Hydrographic Inspector Coast and Geodetic Survey,
Washington, D. C.

List of Naval Officers attached to the United States Coast and Geodetic Survey during the fiscal year ending June 30, 1894.

Name.	Date attached.	Date detached.	Remarks.
LIEUTENANT COMMANDERS.			
S. M. Ackley	Oct. 2, 1889 Reattached Mar. 17, '91	Oct. 30, 1893	
W. I. Moore	Nov. 10, 1891		Still in service.
Jeff. F. Moser	Mar. 2, 1893 Reattached Oct. 30, 1893		Still in service.
LIEUTENANTS.			
Giles B. Harber	Jan. 26, 1892		Still in service.
W. F. Low	Aug. 1, 1894		Still in service.
Robt. G. Peck	June 1, 1893		Still in service.
F. H. Crosby	June 20, 1893		Still in service.
Geo. W. Mentz	July 9, 1892		Still in service.
C. F. Emmerich	Apr. 5, 1893		Died Feb. 3, 1894.
Lucian Flynne	June 6, 1892		Still in service.
J. A. Shearman	Jan. 8, 1894		Still in service.
Jas. H. Sears	Mar. 31, 1894		Still in service.
Walter McLean	Aug. 21, 1893		Still in service.
W. S. Benson	Jan. 6, 1894		Still in service.
LIEUTENANTS—JUNIOR GRADE.			
W. L. Burdick	Aug. 17, 1890	July 31, 1893	
A. C. Almy	Mar. 12, 1894		Still in service.
L. M. Garrett	July 3, 1893		Still in service.
Chas. S. Ripley	May 17, 1892		Still in service.
John Gibson	Mar. 18, 1891	Dec. 26, 1893	
E. H. Tillman	Oct. 8, 1891	June 16, 1894	
R. F. Lopez	July 26, 1893		Still in service.
A. P. Niblack	Feb. 9, 1893	Oct. 29, 1893	
Franklin Swift	July 26, 1892	June 12, 1894	
L. J. Clark	Sept. 18, 1891		Still in service.
Hugh Rodman	Apr. 1, 1891		Still in service.
ENSIGNS.			
J. G. Doyle	July 9, 1891	Feb. 20, 1894	
ENSIGNS—continued.			
J. J. Blandin	Oct. 21, 1893		Still in service.
Chas. P. Eaton	June 23, 1891		Still in service.
W. B. Hoggatt	Jan. 17, 1894		Still in service.
C. P. Plunkett	June 3, 1893		Still in service.
G. W. Kline	Apr. 26, 1892		Still in service.
C. S. Stanworth	Aug. 31, 1892	Dec. 21, 1893	
C. M. McCormick	Apr. 25, 1893		Still in service.
G. Tarbox	Mar. 17, 1892		Still in service.
Benj. Wright	Feb. 20, 1891	Nov. 17, 1893	
J. W. Oman	July 13, 1891		Still in service.
W. S. Cloke	Feb. 20, 1893		Still in service.
Lloyd H. Chandler	June 18, 1893		Still in service.
H. K. Benham	Mar. 31, 1894		Still in service.
F. B. Bassett	June 24, 1893		Still in service.
PASSED ASSISTANT SURGEONS.			
C. J. Decker	Apr. 1, 1892		Still in service.
Chas. H. L. Lowndes	Dec. 1, 1892		Still in service.
Geo. H. Barber	July 10, 1893		Still in service.
ASSISTANT SURGEON.			
J. A. Guthrie	June 1, 1892		Still in service.
PASSED ASSISTANT PAYMASTER.			
Livingston Hunt	May 3, 1893		Still in service.
PAST ASSISTANT ENGINEERS.			
G. Kaemmerling	July 25, 1891	Jan. 18, 1894	
K. McAlpine	July 4, 1892		Still in service.
ASSISTANT ENGINEERS.			
H. G. Leopold	Mar. 30, 1893		Still in service.
Andrew McAllister	Jan. 18, 1894		Still in service.
W. C. Herbert	Mar. 24, 1892		Still in service.

RECAPITULATION.

Lieutenant Commanders	3
Lieutenants	11
Lieutenants (junior grade)	11
Ensigns	15
Passed Assistant Paymaster	1
Passed Assistant Surgeons	3
Assistant Surgeon	1
Passed Assistant Engineers	2
Assistant Engineers	3
	50

NOTE.—From the statement immediately following it appears that of the 50 officers above named, 39 were on duty in the Survey at the close of the fiscal year.

List of Naval Officers attached to the United States Coast and Geodetic Survey June 30, 1894.

COAST AND GEODETIC SURVEY OFFICE.

Lieut. Commander Jeff. F. Moser, Hydrographic Inspector.

Lieut. Walter McLean, Chief of Hydrographic Division.

P. A. Paymaster Livingston Hunt, in charge of Navy Pay Accounts.

Steamer Bache (Atlantic Coast).—Lieut. Robt. G. Peck, commanding; Lieut. W. S. Benson; Ensigns G. W. Kline, C. M. McCormick, and J. W. Oman; P. A. Surg. Geo. H. Barber; Asst. Engineer Andrew McAllister.

Steamer Blake (Atlantic Coast).—Lieut. Geo. W. Mentz, commanding; Lieut. J. A. Shearman; Ensign F. B. Bassett; Asst. Surg. J. A. Guthrie; P. A. Engineer K. McAlpine.

Steamer Endeavor (Atlantic Coast).—Lieut. L. M. Garrett, commanding; Ensigns J. J. Blandin and C. P. Plunkett.

Schooner Eagre (Atlantic Coast).—Lieut. W. F. Low, commanding; Lieut. Chas. S. Ripley; Ensign Lloyd H. Chandler.

Steamer Patterson (Pacific Coast).—Lieut. Commander W. I. Moore, commanding; Lieuts. Jas. H. Sears, R. F. Lopez, and Hugh Rodman; Ensigns W. B. Hoggatt and G. Tarbox; P. A. Surg. C. J. Decker; Asst. Engineer H. G. Leopold.

Steamer Hassler (Pacific Coast).—Lieut. Giles B. Harber, commanding; Lieut. A. C. Almy; Ensigns W. S. Cloke and H. K. Benham; P. A. Surg. Chas. H. T. Lowndes; Asst. Engineer W. C. Herbert.

Steamer McArthur (Pacific Coast).—Lieut. F. H. Crosby, commanding; Ensign Chas. P. Eaton.

Steamer Gedney (Pacific Coast).—Lieut. Lucian Flynne, commanding; Lieut. L. J. Clark.

Names of Vessels, their tonnage, etc., in the service of the United States Coast and Geodetic Survey during the fiscal year ending June 30, 1894.

No.	Name of Vessel.	Tonnage.	Complement of—	
			Officers.	Men.
1	Steamer *Patterson*	453	12	46
2	Steamer *Hassler*	319	10	34
3	Steamer *Blake*	235	10	38
4	Steamer *Bache*	182	10	38
5	Steamer *Gedney*	174	8	29
6	Steamer *McArthur*	130	7	30
7	Steamer *Endeavor*	86	7	24
8	Steamer *Cosmos*	25	3	7
1	Schooner *Eagre*	192	6	26
2	Schooner *Earnest*	80	5	18
3	Schooner *Matchless*	—	5	14
4	Schooner *Quick*	63	4	12
5	Schooner *Transit*	43	3	9
6	Schooner *Spy*	35	3	9

RECAPITULATION.

Steamers	8
Schooners	6
Total	14

OFFICE REPORT No. 3.

REPORT OF THE DISBURSING AGENT FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

United States Coast and Geodetic Survey,
Office of the Disbursing Agent,
Washington, D. C., *February 14, 1895.*

Dear Sir: I beg to submit herewith the accompanying statement of the expenditures for the Coast and Geodetic Survey and for the Office of Standard Weights and Measures for the fiscal year ending June 30, 1894, and for the preceding years embraced within the limits of the law for making such expenditures, as exhibited by the books and records on file in this office, to which your careful attention is respectfully called.

I am, with great respect,

R. J. Griffin,
Disbursing Agent,
United States Coast and Geodetic Survey.

Gen. W. W. Duffield,
Superintendent, Coast and Geodetic Survey,
Washington, D. C.

[House Ex. Doc. No. 324, Fifty-third Congress, third session.]

EXPENDITURES, COAST AND GEODETIC SURVEY, FISCAL YEAR 1894.

Letter from the Secretary of the Treasury, transmitting a detailed statement of the expenditures of the Coast and Geodetic Survey for the fiscal year ended June 30, 1894.

February 19, 1895.—Referred to the Committee on Expenditures of the Treasury Department, and ordered to be printed.

Treasury Department,
Office of the Secretary,
Washington, D. C., *February 18, 1895.*

Sir: In compliance with section 264 of the Revised Statutes of the United States, I have the honor to transmit herewith a statement of the expenditures in the United States Coast and Geodetic Survey for the fiscal year ended June 30, 1894.

Respectfully, yours,

J. G. Carlisle,
Secretary.

Hon. Charles F. Crisp,
Speaker of the House of Representatives.

STATEMENT OF THE EXPENDITURES OF THE U. S. COAST AND GEODETIC SURVEY FOR THE FISCAL YEAR ENDING JUNE 30, 1894.

[Prepared pursuant to act approved March 3, 1853.]

Salaries—Pay of field officers.

To whom paid.	Time employed.	Amount.
SUPERINTENDENT.		
Thomas C. Mendenhall	One year	$6 000·00
ASSISTANTS.		
Charles A. Schott	One year	4 000·00
George Davidson	do	4 000·00
Benjamin A. Colonna	do	3 600·00
Augustus F. Rodgers	do	3 200·00
George A. Fairfield	do	3 000·00
Alonzo T. Mosman	do	3 000·00
William H. Dennis	do	2 966·40
John W. Donn	do	2 800·00
William Eimbeck	do	2 766·20
Herbert G. Ogden	do	2 600·00
Otto H. Tittmann	do	2 566·40
Henry L. Whiting	do	2 400·00
Edward Goodfellow	do	2 400·00
John J. Gilbert	do	2 400·00
Henry L. Marindin	do	2 400·00
Andrew Braid	do	2 366·20
James S. Lawson	Four months, seven days	847·85
Richard M. Bache	One year	2 200·00
Charles H. Boyd	do	2 200·00
Frank Walley Perkins	do	2 200·00
Frank D. Granger	do	1 714·13
Gershom Bradford	do	2 000·00
Spencer C. McCorkle	Eight months, twenty days	1 438·91
Edwin Smith	One year	2 000·00
John F. Pratt	do	2 000·00
Cephas S. Sinclair	do	2 000·00
Edmund F. Dickins	do	2 000·00
Dallas B. Wainwright	do	1 966·20
Richard E. Halter	do	1 800·00
Stehman Forney	do	1 800·00
William C. Hodgkins	do	1 800·00
Erasmus D. Preston	do	1 279·97
James B. Baylor	do	1 800·00
John E. McGrath	do	1 800·00
Isaac Winston	do	1 766·40
Philip A. Welker	do	1 766·40
John A. Flemer	Nine months, seventeen days	1 433·15
Joseph Hergesheimer	One month	151·60
Charles T. Iardella	One year	1 600·00
Washington Irving Vinal	do	1 600·00
Charles H. Van Orden	do	1 600·00
Fremont Morse	Nine months, twelve days	1 252·17
Walter B. Fairfield	Ten months	1 330·40
SUB-ASSISTANTS.		
John A. Flemer	Two months, thirteen days	285·26
Fremont Morse	Two months, eighteen days	304·28
Walter B. Fairfield	Two months	235·80
Fred A. Young	One year	1 400·00
John Nelson	do	1 200·00
George R. Putnam	do	1 200·00
AID.		
John F. Hayford	One year (eight months on furlough)	302·50

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

Salaries—Pay of field officers.

To whom paid.	Time employed.	Amount.
TEMPORARY AIDS.		
Albert L. Baldwin	One year	720·00
Harrison L. Stidham	Three months	180·00
Henri B. von der Trenck	One month, sixteen days	90·10
Charles C. Yates	Three months	180·00
Fred'k V. Moss	do	180·00
Owen B. French	Eight months	478·00
Samuel B. Tinsley	One year	720·00
Robert L. Faris	do	720·00
Expenditures		106 008·32
Appropriation		119 600·00
Expenditures		106 008·32
Unexpended balance		13 591·68

Salaries—Pay of office force.

To whom paid.	Time employed.	Amount.
DISBURSING AGENTS.		
John W. Parsons	Eight months, one day	$1 466·71
Robert J. Griffin	Three months, thirty days	733·29
GENERAL OFFICE ASSISTANT.		
Marshall W. Wines	One year	2 200·00
CHIEF OF DIVISION OF LIBRARY AND ARCHIVES.		
Francis H. Parsons	One year	1 800·00
CLERK TO SUPERINTENDENT.		
Martin Hensel	One year	1 200·00
CLERK TO ASSISTANT IN CHARGE.		
Adelbert B. Simons	One year	1 000·00
CLERKS.		
William B. Chilton	One year	1 650·00
Nicholas G. Henry	do	1 650·00
John H. Smoot	do	1 400·00
William C. Maupin	do	1 400·00
Artemus Martin	do	1 400·00
John W. Whitaker	Three months, two days	306·52
Eugene B. Wills	One year	1 200·00
Freeman R. Green	do	1 191·85
Frank W. Edmunds	do	1 200·00
J. Henry Roeth	do	1 200·00
Asa G. Randall	Five months, fifteen days	546·70
Eugene Rhodes	One year	1 000·00
Sophie S. Hein	Nine months, twenty-two days	809·78
Ida M. Peck	Nine months, twenty-two days	809·78
CHART CORRECTORS.		
Edward H. Wyvill	One year	1 200·00
James H. Barker	do	1 200·00
Archie Upperman	do	763·02
Henry R. Garland	Six months, twelve days	479·35
Mary L. Handlan	Six months, twelve days	383·48
Asa G. Randall	Three months, twenty-five days	229·61

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

Salaries—Pay of office force.

To whom paid.	Time employed.	Amount.
BUOY COLORISTS.		
Jennie H. Fitch	One year	$720·00
Sophie S. Hein	Two months, eight days.	136·85
STENOGRAPHER.		
Harry J. Van Der Beek	One year	720·00
WRITERS.		
Lily A. Mapes	One year	900·00
Virginia Harrison	do	900·00
Kate Lawn	do	800·00
Ida M. Peck	Two months, eight days	136·85
Alice G. Reville	One year	720.00
Alice F. Carlisle	Nine months, twenty days	544·34
Florence Brower	One year	720·00
Thacker V. Walker	One month, twenty-five days	109·51
John Dale	One year	720·00
Ivy Hill	Two months, eight days	136·85
Willie P. Mangum	Five months, fifteen days	327·87
Daniel Hurley	One year	600·00
DRAUGHTSMEN.		
Adolph Lindenkohl	One year	2 400·00
Henry Lindenkohl	do	2 200·00
Edwin H. Fowler	do	2 00·00
William C. Willenbucher	do	1 983·10
Ferdinand Westdahl	do	1 800·00
Ernest J. Sommer	do	1 800·00
Frank C. Donn	do	1 728·19
David M. Hildreth	do	1 400·00
Charles H. Deetz	do	1 364·15
Geo. F. Pohlers	do	1 200·00
Edmund P. Ellis	do	1 134·75
Charles Mahon	do	1 000·00
Paul Erichsen	do	1 000·00
Everett S. Mitchell	Eleven months, twenty-six days	890·09
William R. Doores	Seven months, ten days	550·26
Francis W. Clay	Seven months, two days	530·69
Asa G. Randall	Two months, twenty-one days	202·96
COMPUTERS.		
Alex. S. Christie	Twenty-six days	141·30
Edward H. Courtenay	One year	2 000·00
Myrick H. Doolittle	do	2 000·00
John W. Parsons	Two months, twenty-two days	457·84
John B. Boutelle	One year	$1 600·00
Leland P. Shidy	do	1 600·00
Henry Farquar	do	1 400·00
Daniel L. Hazard	do	1 400·00
Charles H. Kummell	do	1 200·00
Frank M. Little	do	1 200·00
Rollin A. Harris	do	1 200·00
Lilian Pike	do	1 000·00
Harry F. Flynn	do	1 000·00
COPPERPLATE ENGRAVERS.		
William A. Thompson	One year	2 000·00
John G. Thompson	Two months, twenty-two days	456·57
Henry M. Knight	One year	2 000·00
Theodore Wasserbach	do	1 940·19
August Petersen	do	1 800·00

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

Salaries—Pay of office force.

To whom paid.	Time employed.	Amount.
COPPERPLATE ENGRAVERS—continued.		
Edward J. Enthoffer	One year	$1 800·00
William H. Davis	do	1 740·25
Edward H. Sipe	do	1 600·00
William F. Peabody	do	1 480·42
Henry L. Thompson	Eight months, thirteen days	841·29
William A. Van Doren	One year	1 000·00
Alfred H. Sefton	do	900·00
Emil A. Kubel	One month, fifteen days	112·48
George Hergesheimer	One year	837·50
Frank G. Wurdemann	do	737·50
Harry R. McCabe	Eleven months, five days	661·17
Gilbert F. Dawson	One year	600·00
ELECTROTYPER AND PHOTOGRAPHER.		
Daniel C. Chapman	One year	1 800·00
ELECTROTYPER.		
L. P. Keyser	One year	900·00
PLATE PRINTERS.		
Frank Moore	One year	1 600·00
Charles J. Harlow	do	1 000·00
Richard S. Bright	do	1 000·00
Thomas A. Sullivan	One month, nine days	108·66
Eberhard Fordan	One year	1 000·00
Abraham D. Levi	Nine months, eighteen days	798·91
Neil Bryant	One month, twenty-one days	140·09
PLATE PRINTERS' HELPERS.		
William H. Waddington	One year	700·00
Charles F. Locraft	do	700·00
Otto Kemmler	Ten months, seven days	596·16
William H. Horne	One month, nine days	76·12
Louis L. Williams	One year	699.05
Paul Dexter	Eight months, nine days	483·12
Frank C. Gohre	One month, twenty-four days	103·84
Sandy Bruce	Twelve days	22·83
INSTRUMENT MAKERS.		
Ernest G. Fischer	One year	1 800·00
Clement Jacomini	do	1 200·00
William R. Whitman	do	1 000·00
Stephen A. Kearney	do	1 000·00
Clarence E. Regennas	do	1 000·00
Jacob Schwarz	do	1 000·00
Michael Lauxmann, jr	do	700·00
CARPENTERS.		
Horace O. French	One year	1 600·00
George W. Clarvoe	do	900·00
Charles N. Darnall	do	700·00
ENGINEER.		
John A. Watts	One year	1 000·00
JANITOR.		
Walter P. Ramsey	One year	1 200·00
SKILLED LABORER.		
Robert T. Bassett	Seven months, eight days	521·32
WATCHMEN.		
David Parker	One year	880·00
John W. Drum	Eleven months, twenty-five days	865·68

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

Salaries—Pay of office force.

To whom paid.	Time employed.	Amount.
FIREMEN.		
Horace Dyer	One year	$630·00
Harrison Murray	Three months, twenty days	191·74
William H. Butler	Eight months, four days	372·18
MESSENGERS.		
William H. Butler	Three months, twenty-seven days	284·57
P. H. White	Five months, seven days	375. 86
Ed. D. Scott	Eight months	565·85
Charles Over	One year	820·00
Neil Bryant	Ten months, ten days	705·03
Sandy Bruce	Two months, twenty-five days	193·71
Charles H. Jones	One year	820·00
Wm. R. McLane	do	820·00
Vicente Denis	do	820·00
Thomas McGoines	Two months, twenty-eight days	200·58
J. A. Dorsey	Nineteen days	42·80
J. W. Reed	One year	700·00
George Newman	do	700·00
William Savoy	Six months, twenty-eight days	369·78
William West	One year	640·00
Josef K. Hagmann	Eight months, twenty-seven days	473·06
John W. Miner	One month, twenty-five days	96·66
C. E. Yarboro	Two months, twenty-nine days	155·94
William R. White	Two months, five days	116·50
Attrell Richardson	One year	630·00
Dennis E. White	do	550·00
LABORERS.		
John H. Brown	One year	630·00
Baylor Crutchfield	Six months, five days	323·56
Ed. D. Scott	Eleven days	18·83
Boston Brown	One year	550·00
Samuel L. Eubank	Three months, twenty-seven days	117·85
Hans Bowdwin	One year	550·00
Sarah E. Flynn	do	356·08
John H. Mason	do	365·00
Expenditures		137 844·42
Appropriation		143 130·00
Expenditures		137 844·42
Unexpended balance		5 285·58

RECAPITULATION.

Pay of field officers	$106 008·32
Pay of office force	137 844·42
Total expenditures	243 852·74
Total sum appropriated for salaries	262 730·00
Total sum expended for salaries	243 852·74
Unexpended balance	18 877·26

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

Party expenses, 1894.

ATLANTIC COAST.

To whom paid.	On what account.	Amount.
R. M. Bache	Topography	$1 605·91
Chas. H. Boyd	do	2 661·08
Delaware & Hudson Canal Co	Coal for steamer *Bache*	351·92
John W. Donn	Topography	2 548 81
Stehman Forney	Hydrography	2 151·58
L. M. Garrett	Hydrography, steamer *Endeavor*	2 164·82
W. C. Hodgkins	Topography	725·07
C. T. Iardella	do	1 442·33
W. F. Low	Hydrography, schooner *Eagre*	1 899·17
Geo. W. Mentz	Storage	6·00
H. G. Ogden	Topography	268·97
Robert G. Peck	Hydrography, steamer *Bache*	4 394·52
L. A. Pratt	Storage	39·43
O. H. Tittmann	Topography	277·22
W. I. Vinal	do	2 194·30
Henry L. Whiting	Travel	139·00
Expenditures		22 870·13
Appropriation		17 700·00
Add 20 per cent from Gulf Coast, etc		1 680·00
Add 20 per cent from offshore work, etc		1 280·00
Add 20 per cent from magnetics		510·00
Add 16¾ per cent from leveling		703·50
Add 9 per cent from tides, etc		1 017·00
		22 890·50
Expenditures		22 870·13
Unexpended balance		20·37

GULF COAST, ETC.

To whom paid.	On what account.	Amount.
Cary & Co	Coal for steamer *Blake*	$ 376·99
F. W. Clay	Traveling expenses	10·25
Creary & McClintock	Stores for steamer *Blake*	59·83
McKenzie Oerting & Co.	Stores for steamer *Blake* and schooners *Transit* and *Quick*	296·79
G. W. Mentz	Hydrography, steamer *Blake*	1 534·90
E. Walley Perkins	Triangulation and storage	1 088·54
Simpson & Co	Weatherboards for naphtha launch	3·00
J. M. Stone	Oil for steamer *Blake*	36·58
F. Swift	Hydrography, schooner *Transit*	417·92
P. A. Welker	Triangulation and topography	1 498·71
Expenditures		5 323·51
Appropriation		8 400·00
Less 20 per cent transferred to Atlantic Coast	$1 680·00	
Expenditures	5 323·51	7 003·51
Unexpended balance		1 396·49

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

Party expenses, 1894.

OFFSHORE WORK, ETC.

To whom paid.	On what account.	Amount.
Bolton Bros	Stores for steamer *Blake*	$191·45
Castner & Curran	Coal and baskets for steamer *Blake*	180·00
F. W. Clay	Traveling expenses	2·55
Geo. Hall Co	Towing and pontooning steamer *Blake*	800·00
J. Seth Hopkins & Co	Stores for steamer *Blake*	54·30
C. A. Jones & Co	Supplies for steamer *Blake*	47·15
Loud, Claridge & Co	Stores for steamer *Blake*	269·67
W. F. Low	Hydrography, schooner *Eagre*	150·00
G. W. Mentz	Hydrography, steamer *Blake*	2 784·06
Wallace & Bro	Stores for steamer *Blake*	257·46
Expenditures		4 736·64
Appropriation		6 400·00
Less 20 per cent transferred to Atlantic Coast	$1 280·00	
Expenditures	4 736·64	
		6 016·64
Unexpended balance		383·36

PACIFIC COAST.

To whom paid.	On what account.	Amount.
Bureau of Equipment, Navy	Coal for steamer *McArthur*	$283·20
F. H Crosby	Hydrography, steamer *McArthur*	3 803·62
Geo. Davidson	Triangulation, sale of property, etc	188·71
E. F. Dickins	Storage	30·00
W. B. Fairfield	Purchase of outfit	1 235·67
L. Flynne	Hydrography, steamer *Gedney*	6 277·12
J. J. Gilbert	Triangulation, topography, and storage	1 107·08
G. B. Harber	Ship keeping and sale of property	145·49
J. F. Pratt	Combined operations and storage	91·89
A. F. Rodgers	Topography, pasturage, and storage	745·02
J. H. Sears	Hydrography, steamer *McArthur*	6·50
Amount disbursed		13 914·30
Railroad accounts referred for settlement		148·61
Expenditures		14 062·91
Appropriations		18 600·00
Less 18 per cent transferred to Alaska	$3 348·00	
Expenditures	14 062·91	
		17 410·91
Unexpended balance		1 189·09

ALASKA.

To whom paid.	On what account.	Amount.
Adams Express Co	Transportation	$48·05
G. B. Harber	Hydrography, steamer *Hassler*	2 824·78
W. I. Moore	Hydrography, steamer *Patterson*	8 691·74
Amount disbursed		11 564·57
Railroad accounts referred for settlement		25·84
Expenditures		11 590·41
Appropriation		8 400 00
Add 18 per cent from Pacific Coast		3 348·00
		11 748·00
Expenditures		11 590·41
Unexpended balance		157·59

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

Party expenses, 1894.

TIDES, ETC.

To whom paid.	On what account.		Amount.
Henry L. Marindin	Physical hydrography		$3 902·51
H. P. Ritter	Services		1 800·00
Eugene Veith	Sandy Hook Tidal		131·61
J. G. Spaulding	Fort Hamilton Tidal		1 056·41
G. A. Fairfield	Fort Hamilton and Washington Tidal		242·38
Fremont Morse	Sitka Tidal		210·48
George Davidson	Sausalito Tidal		876·50
Aug. F. Rodgers	Sausalito Tidal		172·62
David Hamilton	Newport, R. I., Tidal		182·50
F. V. Moss	Services		480·00
Expenditures			9 055·01
Appropriation			11 300·00
Less 9 per cent transferred to Atlantic Coast		$1 017·00	
Less 10½ per cent transferred to Coast Pilot, etc		1 186·50	
Expenditures		9 055·01	
			11 258·51
Unexpended balance			41·49

COAST PILOT, ETC.

To whom paid.	On what account.	Amount.
L. M. Garrett	Coast Pilot work	$691·93
Talbot Pulizzi	Services	900·00
John Ross	Services and travel	1 501·70
E. H. Tillman	Coast Pilot work	1 011·91
Expenditures		4 105·54
Appropriation		2 950·00
Add 10½ per cent from Tides, etc		1 186·50
		4 136·50
Expenditures		4 105·54
Unexpended balance		30·96

MAGNETICS.

To whom paid.	On what account.		Amount.
George Davidson	Magnetics		$16·20
L. G. Schultz	do		1 800·10
Expenditures			1 816·30
Appropriation			2 550·00
Less 20 per cent transferred to Atlantic Coast		$510·00	
Expenditures		1 816·30	
			2 326·30
Unexpended balance			223·70

LEVELING.

To whom paid.	On what account.		Amount.
Isaac Winston	Precise leveling		$3 489·60
Expenditures			3 489·60
Appropriation			4 200·00
Less 16¾ per cent transferred to Atlantic Coast		$703·50	
Expenditures		3 489·60	
			4 193·10
Unexpended balance			6·90

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

Party expenses, 1894

STATE SURVEYS.

To whom paid.	On what account.	Amount.
E. A. Bowser	Triangulation	$1 158·60
A. H. Buchanan	do	1 914·13
George Davidson	California and Nevada boundary	4 728·53
G. A. Fairfield	Traveling expenses	72·97
W. B. Fairfield	do	73·25
Stehman Forney	Reconnaissance and storage	3 611·21
W. R. Hoag	Triangulation	1 080·57
W. C. Hodgkins	do	255·27
Aug. F. Rodgers	California and Nevada boundary	12·17
C. H. Sinclair	Traveling expenses	76·30
Amount disbursed		12 983·00
Railroad accounts referred for settlement		871 80
Expenditures		13 854·80
Appropriation		15 600·00
Less 10 per cent transferred to transcontinental work	$1 560·00	
Expenditures	13 854·80	
		15 414·80
Unexpended balance		185·20

GRAVITY, ETC.

To whom paid.	On what account.	Amount.
George Davidson	Longitudes	$75·70
Fauth & Co	Gravity observations	150·00
T. C. Mendenhall	Traveling expenses	21·80
E. D. Preston	Gravity experiments and observations at Chicago	137·75
G. R. Putnam	Gravity experiments and observations at Washington	432·53
C. H. Sinclair	Longitudes and latitudes	741·90
Tice & Lynch	Gravity experiments and triangulation	46·41
F. A. Wolff, jr	Services	225·00
Expenditures		1 831·09
Appropriation		4 650·00
Less 15 per cent transferred to transcontinental work	$697·50	
Expenditures	1 831·09	
		2 528·59
*Unexpended balance		2 121·41

*This balance will be reduced by outstanding obligation.

TRANSCONTINENTAL WORK.

To whom paid.	On what account.	Amount.
Wm. Eimbeck	Triangulation, storage, and pasturage	$9 335·21
F. D. Granger	Triangulation and storage,	2 001·49
A. Larkin	Storage	3·00
F. W. Perkins	Reconnaissance, triangulation, pasturage, and storage	1 661·06
P. A. Welker	Triangulation	1 263·34
Amount disbursed		14 264·10
Railroad accounts referred for settlement		373·57
Expenditures		14 637·67
Appropriation		12 600·00
Add 10 per cent from State surveys		1 560·00
Add 15 per cent from gravity, etc		697·50
		14 857·50
Expenditures		14 637·67
Unexpended balance		219·83

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

Party expenses, 1894.

NAVY TRAVEL, ETC.

To whom paid.	On what account.	Amount.
S. M. Ackley, U. S. Navy	Mileage	$242·00
A. C. Almy, U. S. Navy	do	73·36
G. H. Barber, U. S. Navy	do	9·68
F. B. Bassett, U. S. Navy	do	33·44
H. K. Benham, U. S. Navy	do	255·52
W. S. Benson, U. S. Navy	do	3·20
J. J. Blandin, U. S. Navy	do	71·52
L. J. Clark, U. S. Navy	do	3·28
C. P. Eaton, U. S. Navy	do	72·88
C. F. Emmerick, U. S. Navy	do	73·36
L. M. Garrett, U. S. Navy	do	46·48
W. B. Hoggatt, U. S. Navy	do	255·84
R. F. Lopes, U. S. Navy	do	338·72
A. McAllister, U. S. Navy	do	7·76
W. McLean, U. S. Navy	do	26·24
G. W. Mentz, U. S. Navy	do	6·40
J. F. Moser, U. S. Navy	do	516·00
R. G. Peck, U. S. Navy	do	36·48
C. P. Plunkett, U. S. Navy	do	68·40
C. S. Ripley, U. S. Navy	do	51·46
J. H. Sears, U. S. Navy	do	255·84
J. A. Shearman, U. S. Navy	do	6·80
E. H. Tillman, U. S. Navy	do	3·20
Expenditures		2 457·86
Appropriation		2 950·00
Expenditures		2 457·86
Unexpended balance		492·14

OBJECTS NOT NAMED.

To whom paid.	On what account.	Amount.
John Brown	Services and incidental expenses	$606·00
A. H. Buchanan	Traveling expenses	47·80
George Davidson	Travel and astronomical work	443·08
E. F. Dickins	Traveling expenses	332·75
J. J. Gilbert	do	309·45
W. R. Hoag	do	71·50
Wm. Holmes	Services	19.36
W. O. Luscombe	Storage	20·00
G. W. Mentz	Outfit for steamer *Bache*	15·70
W. I. Moore	Ways and boathouse for steam launch *Cosmos*	402·90
Fremont Morse	Traveling expenses	322·40
George Olsen	Services	487·10
Puget Sound Dry Dock Co	Ship keeping	198·38
F. W. Perkins	Traveling expenses	130·00
J. F. Pratt	do	345·60
C. F. Schiodt	Services	600·00
C. H. Van Orden	Leveling	411·12
P. A. Welker	Traveling expenses	104·94
H. L. Whiting	do	125·83
Amount disbursed		4 993·91
Railroad accounts referred for settlement		1·25
Expenditures		4 995·16
Appropriation		5 900·00
Expenditures		4 995·16
*Unexpended balance		904·84

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*This balance will be reduced by outstanding obligation.

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

Party expenses, 1894.

RECAPITULATION.

[Showing expenditures in gross (by subitems) on account of the appropriation for party expenses, 1894.]

Subitems.	Amount.
Atlantic Coast	$22 870·13
Gulf Coast, etc	5 323·51
Offshore work, etc	4 736·64
Pacific Coast	13 914·30
Alaska	11 564·57
Tides, etc	9 055·01
Coast Pilot, etc	4 105·54
Magnetics	1 816·30
Leveling	3 489·60
State surveys	12 983·00
Gravity, etc	1 831·09
Transcontinental work	14 264·10
Navy travel, etc	2 457·86
Objects not named	4 993·91
Amount disbursed	113 405·56
Railroad accounts referred to accounting officers for settlement	1 421·07
Expenditures	114 826·63
Total amount appropriated for party expenses, 1894	122 200·00
Total amount expended for party expenses, 1894	114 826·63
Unexpended balance	7 373·37

CLASSIFICATION OF EXPENDITURES FOR PARTY EXPENSES, 1894.

On what account.	Amount.
Triangulation	$4 338·01
Topography	15 576.57
Hydrography	45 408·71
Transcontinental geodetic work	15 111·04
Points for State surveys	13 242·56
Coast Pilot	4 105·54
Leveling	3 900·72
Magnetics	1 816·30
Physical hydrography	3 902·51
Geographical positions	1 260·68
Tidal operations	5 152·50
Gravity experiments	1 011.49
Total	114 826·63

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

Alaska Boundary Survey.

[From March 1, 1894, to January 31, 1895.]

To whom paid.	On what account.	Amount.
E. F. Dickins	Boundary survey	$2 316·70
J. A. Flemer	do	1 469·17
Giles B. Harber, U. S. Navy	do	166·09
John E. McGrath	do	2 948·68
Fremont Morse	do	898·57
J. F. Pratt	do	5 430·22
Homer P. Ritter	do	1 412·37
S. B. Tinsley	Traveling expenses	50·30
Amount disbursed		14 692·10
Railroad accounts referred for settlement		246·25
Expenditures		14 938·35
Unexpended balance on hand March 1, 1894		26 261·96
Repayment to credit of appropriation certificate of deposit, No. 14 211		20·00
		26 281·96
Expenditures		14 938·35
Present unexpended balance		11 343·61

Repairs of vessels, 1894.

To whom paid.	On what account.	Amount.
Brown Dry Dock Co	Steamer *Bache*	$112·44
Brown & Miller	Steamer *Bache*	5 223·76
Campbell & Zell Co	Steamer *Blake*	472·02
Clay & Torbensen	Purchase of four steam launches	5 455·00
Creary & McClintock	Steamer *Blake*	45·05
F. H. Crosby, U. S. Navy	Steamer *McArthur*	2 820·29
Lucian Flynne, U. S. Navy	Steamer *Gedney*	498·65
L. M. Garrett, U. S. Navy	Steamer *Endeavor*	2 068·38
A. F. Grant	Steamer *Bache*	54·00
G. B. Harber, U. S. Navy	Steamer *Hassler*	602·12
G. B. Harber, U. S. Navy	Steamer *Fuca*	60·38
J. Hoodless	Schooner *Quick*	45·25
J. Hoodless	Schooner *Transit*	38·25
W. F. Low, U. S. Navy	Schooner *Eagre*	620·27
G. W. Mentz, U. S. Navy	Steamer *Blake*	813·08
W. I. Moore, U. S. Navy	Steamer *Patterson*	2 430·65
Morris, Tacker & Co	Steamer *Blake*	216·00
R. G. Peck, U. S. Navy	Steamer *Bache*	2 518·10
F. Swift, U. S. Navy	Schooner *Transit*	103·45
W. E. Woodall & Co	Steamer *Blake*	664·98
Expenditures		24 862·12
Appropriation		25 000·00
Expenditures		24 862·12
Unexpended balance		137·88

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

Classification of Expenditures for Repairs of Vessels, 1894.

Name of vessel.	Amount.
Steamer *Bache*	$7 908·30
Steamer *Blake*	2 211·13
Schooner *Eagre*	620·27
Steamer *Endeavor*	2 068·38
Steamer *Fuca*	60·38
Steamer *Gedney*	498·65
Steamer *Hassler*	602·12
Steamer *McArthur*	2 820·29
Steamer *Patterson*	2 430·65
Schooner *Quick*	45·25
Schooner *Transit*	141·70
Steam launches (purchase of)	5 455·00
Total	24 862·12

Publishing observations, 1894.

To whom paid.	On what account.	Amount.
Frederick V. Moss	Services	$60·00
H. L. Stidham	do	210·00
Frank A. Wolff, jr	do	45·00
Chas. C. Yates	do	148·00
Expenditures		463·00
Appropriation		1 000·00
Expenditures		463·00
Unexpended balance		537·00

General expenses, 1894.

INSTRUMENTS, INSTRUMENT SHOP, CARPENTER SHOP, DRAWING DIVISION, BOOKS, MAPS, CHARTS, AND SUBSCRIPTIONS.

To whom paid.	On what account.	Amount.
D. Appleton & Co	Subscriptions	$5·00
Astronomical Journal	Books	5·00
Astronomy and Astro-Physics	Subscriptions	4·00
Wm. Ballantyne & Sons	Books	6·50
D. Ballauf	Instrument shop	49·50
Baltimore Oil and Grease Co	do	42·50
Louis M. Baum	Instruments	3·50
Robert Beall	Books	3·00
Charles Becker	Carpenter shop	10·17
Benedict-Burnham Manufacturing Co	Instrument shop	252·78
John A. Brashear	do	17·50
Brown & Sharp Manufacturing Co	do	2·00
Buff & Berger	Instruments	1 751·00
E. W. Bullinger	Subscriptions	4·50
J. H. Bunnell & Co	Instrument shop	17·80
T. E. Butters	do	24·29
John W. Cadby	Books	1·25
Wm. J. Campbell	do	2·00
Chas. T. Carter & Co	Instrument and carpenter shops	40·93
The Celluloid Co	Instrument shop	22·00
J. B. Chamberlain	do	14·53
John Chatillon & Sons	Instruments	24. 25
J. H. Chesley & Co	Instrument and carpenter shops	7·64

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

General expenses, 1894.

INSTRUMENTS, INSTRUMENT SHOP, CARPENTER SHOP, DRAWING DIVISION, BOOKS, MAPS, CHARTS, AND SUBSCRIPTIONS—Continued.

To whom paid.	On what account.	Amount.
Church & Stephenson	Carpenter shop	$5·00
George V. Cresson & Co	Instrument shop	4·25
Criterion Photo. Supply Co	Instruments	37·80
Jas. D. & E. S. Dana	Subscriptions	6·00
Darling, Brown & Sharp	Instruments	6·00
Darnall & Upham	Books	5·00
George Davidson	Instrument shop subscriptions, etc	88·05
Doremus & Co	Instrument shop	7·20
Doremus & Just	do	·50
Edw. L. Dent Iron Works	do	30·05
Egyptian Lacquer Manufacturing Co	do	11·70
Alfred Ely & Co	do	38·42
George T. Ennis	do	45·97
Fauth & Co	Instruments	1 325·00
Lucian Flynne, U. S. Navy	Books	4·00
M. N. Forney	Subscriptions	3·00
Frost & Adams	Drawing	290·00
Geological Publishing Co., The	Subscriptions	3·50
Z. D. Gilman	Carpenter and instrument shops	54·73
Ginn & Co	Subscriptions	3·00
Eli Goodwin	Maps	10·00
Henry J. Green	Instrument and instrument shop	190·15
L. R. Hamersley & Co	Books	8·75
Harris & Shearer	Instrument shop	24·68
H. Hoffa	do	8·80
A. Hurlimann	Instruments	401·47
E. E. Jackson & Co	Carpenter shop	3·75
The Johns Hopkins Press	Book	7·50
The W. J. J. Johnson Co. (limited)	Subscriptions	3·00
Jones & Laughlins (limited)	Instrument shop	9·07
M. E. Kahler	Instruments and instrument shop	273·40
J. Karr	do	132·35
W. H. Kemp & Co	Instrument shop	12·45
Keuffel and Esser Co	Instruments and instrument shop	125·14
I. Y. Knight	Books	17·00
Libbey, Bittinger & Miller	Carpenter shop	329·18
Frank Libbey & Co	do	24·05
Library Bureau	Books	144·68
Melville Lindsay	Instrument shop	7·74
Geo. E. Littlefield	Books	8.50
Howard Lockwood & Co	do	12·00
Lowdermilk & Co., W. H	do	89·60
Lutz & Bro	Instrument shop	5·25
F. P. May & Co	Instrument and carpenter shops	58·51
McFadden Co	Instrument shop	50·12
McMillan & Co	Subscriptions	3·00
W. H. Mehler	Instrument shop	3·50
T. C. Mendenhall	Books	2·50
W. W. Mildrum	Instrument shop	16·00
Edward Miller	Subscriptions	12·00
Francis Miller	Carpenter shop	3·15
John Milne	Books and subscriptions	21·50
W. B. Moses & Son	Carpenter shop	·75
Munn & Co	Subscriptions	7·00
J. B. Nallo	Instrument and carpenter shops	58·10
T. S. & J. D. Negus	Instrument shop	156·50
John C. Parker	Books and subscriptions	50·00
Francis H. Parsons	Books	·55

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

General expenses, 1894.

INSTRUMENTS, INSTRUMENT SHOP, CARPENTER SHOP, DRAWING DIVISION, BOOKS, MAPS, CHARTS, AND SUBSCRIPTIONS—Continued.

To whom paid.	On what account.	Amount.
Robert G. Peck, U. S. N	Instrument shop	$46·00
A. Pessler	Instruments	47·70
Chas. H. Pleasants	Instrument and carpenter shops	15·14
Pratt & Whitney Co	Instrument shop	740·00
Publishers' Weekly	Subscriptions	5·00
E. J. Pullman	Instruments	43·21
Queen & Co	do	2·75
Rand, McNally & Co	Maps	6·40
Arthur W. Robson	Books	2·00
J. S. Rowland	Instrument shop	1·10
Royce & Marean	do	51·91
Geo. Ryneal, jr	Instrument and carpenter shops	67·09
Fred. A. Schmidt	Instruments	188·80
L. H. Schneider's Son	Instrument and carpenter shops	22·65
J. L. Shaw	Books	24·00
Thos. W. Smith	Carpenter shop	36·68
Thos. Sommerville & Sons	Instrument shop	9·59
Gustav E. Stechert	Books	492·77
E. Steiger & Co	do	8·50
D. B. Stevens	Subscriptions	3·65
I. H. Steward	Instruments	22·24
Sussford & Lorsch	do	139·50
Ormond Stone	Books	2·00
A. P. Swoyer & Co	Instrument shop	19·52
M. A. Tappan	do	7·30
Tice & Lynch	Instruments and instrument shop	42·90
Henry Tripp	Instrument shop	2·50
U. S. Naval Institute	Subscriptions	3·50
C. W. Walker	Instrument shop	9·00
Willis C. Walker & Co	Instruments	475·00
Edgar S. Werner	Books	3.75
B. Westermann & Co	Books and subscriptions	249·40
Stillman White	Instrument shop	14·56
Williams & Hanks	Instrument and carpenter shops	31·29
Wilbur T. Wilson	Books	2·50
Joseph Zentmayer	Instrument shop	2·90
The Zucker Levett Chemical Co	do	5·20
Expenditures		9 420·50
Appropriation		9 000·00
Received for instruments furnished the Bureau of Equipment, Navy Department		630·40
Received for instruments furnished the Light-House Board		60·00
		9 690·40
Expenditures		9 420·50
Unexpended balance		269·90

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

General expenses, 1894.

COPPERPLATES, CHART PAPER, PRINTING INK, COPPER, ZINC, AND CHEMICALS FOR ELECTROTYPING AND PHOTOGRAPHING; ENGRAVING, PRINTING, PHOTOGRAPHING, AND ELECTROTYPING SUPPLIES; EXTRA ENGRAVING AND DRAWING; PHOTOLITHOGRAPHING AND PRINTING FROM STONE AND COPPER FOR IMMEDIATE USE.

To whom paid.	On what account.	Amount.
Jas. L. Barbour & Son	Electrotyping and photographing supplies	$0·10
Chas. Becker	Electrotyping, photographing, and printing supplies	2·31
Henry H. Brown	Electrotyping and photographing supplies	23·45
Bureau of Engraving and Printing	Printing supplies	815·92
Charles T. Carter & Co	do	2·36
J. B. Chamberlain	Electrotyping and photographing supplies	3·30
J. H. Chesley & Co	Printing supplies	2·78
Clendenin Bros	Copperplates, electrotyping and photographing supplies	775.50
George Davidson	Photographing supplies	2·80
Chas. F. Deitrich	Printing supplies	3.25
Easton & Rupp	do	13·05
E. Morrison Paper Co	Printing and photographing supplies	34.80
J. C. Entwistle	Extra engraving	2.50
J. C. Ergood & Co	Printing supplies	·39
Evans & Bartle	Extra engraving	2 750·00
Friedenwald Company	Photolithographing	261·51
Forbes Lithograph Manufacturing Co	do	22·50
Henry R. Garland	Extra drawing	338·10
Peter H. Geddes	Extra engraving	1 407·79
C. D. Gildersleeve's Son	Printing supplies	80·00
Z. D. Gilman	Engraving, electrotyping, and photographing supplies	510.21
Andrew B. Graham	Photolithographing	110·00
E. N. Gray & Co	Printing supplies	187·55
Mary L. Handlan	Extra drawing	328·96
A. Hoen & Co	Photolithographing	148·40
H. Hoffa	Printing and engraving supplies	8·53
J. E. Hurley	Printing supplies	79·50
Chas. Eneu Johnson & Co	do	6·00
Keuffel & Esser Co	Electrotyping, photographing, and printing supplies	12·50
Ernest Kubel	Copperplate and engraving supplies	1 727·30
Melville Lindsay	Electrotyping and photographing supplies	14·44
Wm. Mackenzie	Extra engraving	1 440·00
Mackey Print Paper Co	Electrotyping and photographing supplies	14·00
Robert Mayer & Co	Printing supplies	9·00
F. P. May & Co	Printing and engraving supplies	1·40
Thos. H. McCollins & Co	Photographing supplies	2·50
McFadden Co	Printing supplies	·25
W. H. Mehler	do	16·75
Francis Miller	Electrotyping, photographing, and engraving supplies	1·05
David Morris	Extra engraving	1 373·79
Mount Holly Paper Co	Chart paper	49·75
J. B. Nalle	Engraving and printing supplies	137·60
Norris Peters Co	Photolithographing	625·75
New York Engraving and Printing Co	do	23·00
Peter Adams Co	Chart paper and photolithographing	3 746·75
Chas. H. Pleasants	Electrotyping, photographing, and printing supplies	131·97
E. J. Pullman	Electrotyping and photographing supplies	43·01
Geo. Ryneal, jr	Electrotyping, photographing, and printing supplies	64·75
Julius F. Sachse	Photographing supplies	15·00
Sacket & Wilhelms Lithographing Co	Photolithographing	30·00
E. G. Schaeffer & Co	Electrotyping supplies	1·50
Scheller & Stevens	do	·27
S. S. Shedd & Bro	Printing supplies	186·50
Augustine Smith & Co	Chart paper	10·00
Strobridge Lithographing Co	Photolithographing	697·90

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

General expenses, 1894.

COPPERPLATES, CHART PAPER, PRINTING INK, COPPER, ZINC, ETC.—Continued.

To whom paid.	On what account.	Amount.
A. P. Swoyer & Co	Engraving supplies	$1·14
H. L. Thompson	Extra engraving	358·06
O. L. Wolfsteimer & Co	Electrotyping and photographing supplies	4·80
Expenditures		18 662·29
Appropriation		20 000·00
Received from the Hydrographic Office, Navy Department, for electrotyping done for that Bureau		522·45
		20 522·45
Expenditures		18 662·29
Unexpended balance		1 860·16

STATIONERY, TRANSPORTATION OF INSTRUMENTS AND SUPPLIES, OFFICE WAGON AND HORSES, FUEL, GAS, TELEGRAMS, ICE, AND WASHING.

To whom paid.	On what account.	Amount.
Adams Express Co	Transportation	$191·55
William Ballantyne & Sons	Stationery	42·09
J. Baumgarten & Son	do	40·25
Robert Beall	do	1·50
B. and O. R. R. Co	Transportation	9·51
Thomas Collins	do	·69
Columbian Supply Co	Fuel	1 219·40
James Connor	Office horses	29·25
George Davidson	Stationery and washing	21·00
Easton & Rupp	Stationery	5·10
Chas. P. Echols	Transportation	2·15
E. Morrison Paper Co	Stationery	24·45
George W. Knox Express	Transportation	46·86
Z. D. Gilman	Stationery	7·80
W. A. Glassford	Transportation	11·95
Great Northwestern Telegraph Co	Telegrams	2·29
Harriet E. Harrod	Washing	152·79
Hygienic Ice Co	Ice	227·50
John Kennedy	Fuel	224·10
Lutz & Bro	Office horse and wagon	13·00
Thomas R. Martin	Fuel	60·20
John McDermott & Bro	Office wagon	42·00
G. W. Mentz	Stationery	·40
John C. Parker	do	64·85
People's Dispatch Co	Transportation	1·10
Arthur W. Robson	do	1·20
Aug. F. Rodgers	Stationery	·25
Fred Schmidt	do	638·20
B. F. Shaw	Office horses	240·00
Smithsonian Institution	Transportation	57·15
Samuel Springman	Transportation	1·50
Stationery division, Treasury Department	Stationery	635·71
Stephenson's Express	Transportation	18·34
Tice & Lynch	do	6·05
Henry Turner	do	·75
United States Express Co	do	122·65
Washington Gaslight Co	Gas	1 606·88
Charles Werner	Fuel	4·99
Western Union Telegraph Co	Telegrams	60·18

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

General expenses, 1894.

STATIONERY, TRANSPORTATION OF INSTRUMENTS AND SUPPLIES, OFFICE WAGON AND HORSES, ETC.—Continued.

To whom paid.	On what account.	Amount.
Wyckoff, Seamans & Benedict	Stationery	$25·50
Zucker Levett Chemical Co	Transportation	·25
Amount disbursed		5 861·38
Railroad accounts referred for settlement		2·16
Expenditures		5 863·54
Appropriation		6 000·00
Expenditures		5 863·54
Unexpended balance		136·46

MISCELLANEOUS EXPENSES, CONTINGENCIES OF ALL KINDS; OFFICE FURNITURE, REPAIRS, EXTRA LABOR, AND TRAVELING EXPENSES (OFFICE).

To whom paid.	On what account.	Amount.
American Automatic Protective Co	Supplies	$10·00
Jas. L. Barbour & Son	do	57·71
Chas. E. Barrick	Repairs	224·95
J. Baumgarten & Son	do	6·00
Chas. Becker	Supplies	7·00
Edmund G. Bell	Extra labor	12·00
Boswell, Copeland & Merking	Office furniture	12·50
J. W. Boteler & Son	Supplies	9.80
Capital Publishing Co	Advertising	4·18
Chas. T. Carter & Co	Supplies	4·00
Chesapeake & Potomac Tel. Co	Rental	100·00
J. H. Chesley & Co	Supplies	5·76
Chronicle	Advertising	6·60
Columbia Automatic Filter Co	Water filters	115·00
Columbia Phone Co	Rental of graphophone	158·97
M. G. Copeland & Co	Supplies	74·00
Craig & Harding	do	170·48
Darnall & Jennings	Repairs	6·50
George Davidson	Suboffice expenses	47·77
Victor C. DeCordy	Repairs	75·00
Deutsche Press	Advertising	4·80
E. Morrison Paper Co	Cutting paper	2·50
J. C. Ergood & Co	Flour	2·62
Evening Star Newspaper Co	Advertising	28·05
Frank Freeman	Making and laying carpet	42·37
Z. D. Gilman	Supplies	7·88
Maria Green	Removing ashes	36·45
Sarah Green	do	12·60
Chas. T. Halloway	Fire extinguishers	500·00
Jackson, Jones & Co	Cement and sand	3·75
Stevens H. Jecko	Supplies	17·50
Wm. A. Johnson	Repairs	7·00
H. Sidney King	Extra labor	884·27
George Leach	do	31·50
Lutz & Bro	Supplies	2·50
F. P. May & Co	do	15·98
John McDermott & Bro	do	9·00
W. H. Mehler	Repairs	10·15
J. T. Mockabee	Fertilizers	7·00
E. Montrop & Co	Lettering sign	20·00
Wm. B. Morgan	Magnesia covering	215·00
The Morning Herald	Advertising	14·14

EXPENDITURES COAST AND GEODETIC SURVEY, 1894.

General expenses, 1894.

MISCELLANEOUS EXPENSES, CONTINGENCIES OF ALL KINDS, ETC.—Continued.

To whom paid.	On what account.	Amount.
W. B. Moses & Sons	Office furniture, etc	$47·15
J. B. Nalle	Supplies	87·23
National Economist Publishing Co	Advertising	9.45
Wm. N. Newbold	Extra labor	18·00
News Publishing Co	Advertising	3·75
John C. Parker	Supplies	5.40
Wm. C. Peake	Repairs	61·40
Petit & Dripps	Water coolers	40·00
Chas. H. Pleasants	Supplies	·80
Ratcliffe, Darr & Co	Sale of property	21·13
W. F. Roberts	Repairs to typewriter	8·50
Aug. F. Rodgers	Suboffice and traveling expenses	14·45
Geo. Ryneal, jr	Supplies	4·20
E. G. Schaeffer & Co	do	14·04
Scheller & Stephens	do	5·55
L. H. Schneider's Son	do	13·15
Geo. R. Seiffert	Type cleaners	8·00
J. W. Shane	Repairs	249·00
Henry Steinberg	do	32·00
Superintendent's Office, Treasury Department	Office furniture	295·15
W. F. Thomlinson & Co	Typewriting attachment	9·00
H. O. Towels	Office furniture	38·00
Volks Tribune	Advertising	4·80
Washington City Post Office	Box rent	20·00
Washington News Publishing Company	Advertising	8·32
Washington Post Co	do	9·25
Washington Sentinel	do	5·67
Washington Times Publishing Company	do	11·20
Frank R. Watts	Supplies	12·25
Wilmarth & Edmonston	do	20·70
Wykoff, Seamens & Benedict	Typewriting supplies	8·18
Yost Writing Machine Co	Repairing typewriter	10·00
Wm. Young	Extra labor	355·65
F. H. Youngs	Cleaning carpets	20·60
Expenditures		4 455·25
Appropriation		4 500·00
Expenditures		4 455·25
Unexpended balance		44·75

RECAPITULATION.

[Showing expenditures in gross (by subitems) on account of the appropriation for general expenses, 1894.]

Subitems.	Amount.
Instruments, instrument shop, carpenter shop, drawing division, books, maps, charts, and subscriptions	$9 420·50
Copperplates, chart paper, printing ink, copper, zinc, and chemicals for electrotyping and photographing; engraving, printing, photographing, and electrotyping supplies; extra engraving and drawing; photolithographing and printing from stone and copper for immediate use	18 662·29
Stationery, transportation of instruments and supplies; office wagon and horses, fuel, gas, telegrams, ice, and washing	5 861·38
Miscellaneous expenses, contingencies of all kinds, office furniture, repairs, extra labor, and traveling expenses (office)	4 455·25
Total disbursements	38 399·42
Railroad accounts referred for settlement	2·16
Total expenditures	38 401·58
Total amount appropriated for general expenses, 1894	39 500·00
Received for instruments furnished the Bureau of Equipment, Navy Department	630·40
Received for instruments furnished the Light-House Board	60·00
Received from the Hydrographic Office, Navy Department, for electrotyping done for that Bureau	522·45
	40 712·85
Total amount expended for general expenses, 1894	38 401·58
Unexpended balance	2 311·27

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

CLASSIFICATION OF EXPENDITURES FOR GENERAL EXPENSES, 1894.

On what account.	Amount.	On what account.	Amount.
Instruments	$5 090·75	Stationery	$1 496·10
Instrument shop	2 166·43	Transportation of instruments and supplies	471·70
Carpenter shop	602·97	Office wagon and horses	324·25
Drawing division	290·00	Fuel	1 508·69
Books, maps, and charts	1 132·45	Gas	1 606·88
Subscriptions	137·90	Telegrams	62.47
Copperplates	1 845·75	Ice	227·50
Chart paper	3 742·18	Washing	163·79
Engraving, printing, and photographing, and electrotyping supplies	3 091·78	Miscellaneous expenses and contingencies of all kinds	2 052·85
Extra engraving	7 332·14	Office furniture	402·30
Extra drawing	667.06	Extra labor	1 301·42
Photolithographing and printing from stone and copper for immediate use	1 983.38	Repairs	698·68
		Total	38 399·42

Salaries—Standard Weights and Measures, 1894.

To whom paid.	Time employed.	Amount.
ADJUSTER.		
Louis A. Fischer	One year	$1 500·00
MECHANICIAN.		
Otto Storm	One year	1 250·00
ASSISTANT MESSENGER.		
Charles A. Harbaugh	One year	720·00
WATCHMEN.		
David Somerville	Three months	180·00
J. A. McDowell	Eight months, twenty-one days	520·49
Expenditures		4 170·49
Appropriation		4 190·00
Expenditures		4 170·49
Unexpended balance		19·51

Contingent expenses—Standard Weights and Measures, 1894.

MATERIALS AND APPARATUS AND INCIDENTAL EXPENSES.

To whom paid.	On what account.	Amount.
Wm. Ballantyne & Son	Materials	$28·50
D. Ballauf	do	41·00
Charles E. Barrick	Plumbing	4·50
Eimer & Amend	Materials, etc	145·37
Z. D. Gilman	Chamois skins	3·90
Tice & Lynch	Services	61·83
Manhattan Plate Glass Co	Plate glass	13·00
J. B. Nalle	Materials, etc	8·60
John C. Parker	do	5·00
Henry Troemner	Glass disks	25·20
U. S. Mint, Philadelphia	Pure gold	13·42
Expenditures		350·32
Appropriation		975·00
Expenditures		350·32
Unexpended balance		624·68

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

GENERAL RECAPITULATION.

[Showing appropriations, expenditures, and balances for the fiscal year ending June 30, 1894; also unexpended balance on Alaska boundary survey, and amounts received from other Government Bureaus.]

Name of appropriation.		Appropriated.	Expended.	Balances.
Salaries—Pay of field officers		$119 600·00	$106 008·32	$13 591·68
Salaries—Pay of office force		143 130·00	137 844·42	5 285·58
Party expenses		122 200·00	114 826·63	7 373·37
Alaska boundary survey:				
Balance from last report	$26 261·96	26 281·96	14 938·35	11 343·61
Repayment from E. F. Dickins	20·00			
Repairs of vessels		25 000·00	24 862·12	137·88
Publishing observations		1 000·00	463·00	537·00
General expenses:				
Sundry Civil Act March 3, 1893	$39 500·00	40 712·85	38 401·58	2 311·27
Received from Bureau of Equipment, Navy Department	630·40			
Received from Light-House Board	60·00			
Received from Hydrographic Office	522·45			
Salaries—Weights and Measures		4 190·00	4 170·49	19·51
Contingent expenses—Weights and Measures		975·00	350·32	624·68
Total		483 089·81	441 865·23	41 224·58

		Amount.
Amounts appropriated and available as follows:		
Appropriations for Coast and Geodetic Survey proper for fiscal year ending June 30, 1894, Sundry Civil Act March 3, 1893		$450 430·00
Appropriations for Office of Standard Weights and Measures, Legislative Act March 3, 1893		5 165·00
Received from other Government Bureaus for materials and work		1 212·85
Balance from last report on account of Alaska boundary survey		26 261·96
Repayment from E. F. Dickins on account of Alaska boundary		20·00
		483 089·81
Amounts expended as follows:		
For Coast and Geodetic Survey	$422 406·07	
For Office of Standard Weights and Measures	4 520·81	
For Alaska boundary survey	14 938·35	
		441 865·23
Total unexpended balance		41 224·58

EXPENDITURES SINCE LAST REPORT ON ACCOUNT OF THE APPROPRIATIONS FOR THE SERVICE OF THE FISCAL YEAR ENDING JUNE 30, 1893.

Party expenses, 1893.

PACIFIC COAST.

To whom paid.	On what account.	Amount.
J. F. Pratt	Storage	$10·50
Expenditures		10·50
Balance on hand—Report for 1893		33·22
Expended since, as above		10·50
Present unexpended balance		22·72

STATE SURVEYS.

To whom paid.	On what account.	Amount.
Chicago, Milwaukee and St. Paul R. R.	Transportation	$12·40
Amount disbursed		12·40
Railroad accounts referred for settlement		5·05
Expenditures		17·45
Balance on hand—Report for 1893		176·65
Expended since, as above		17·45
Present unexpended balance		159·20

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

Party expenses, 1893.

GRAVITY, ETC.

To whom paid.	On what account.	Amount.
Geo. W. Knox Express	Transportation	$36·91
T. S. & J. D. Negus	Gravity determination	1 700·00
Amount disbursed		1 736·91
Railroad accounts referred for settlement		21·83
Expenditures		1 758·74
Balance on hand—Report for 1893		1 819·47
Expended since, as above		1 758·74
Present unexpended balance		60·73

TRANSCONTINENTAL WORK.

To whom paid.	On what account.	Amount.
William Eimbeck	Triangulation	$6·00
Balance on hand—Report for 1893		29·71
Expended since, as above		6·00
Present unexpended balance		23·71

OBJECTS NOT NAMED.

	Amount.
Balance on hand—Report for 1893	$20·73
Railroad accounts referred for settlement	5·30
Present unexpended balance	15.43

RECAPITULATION.

[Showing expenditures in gross by subitems.]

Pacific Coast	$10·50
State Surveys	12·40
Gravity, etc	1 736·91
Transcontinental work	6·00
Amount disbursed	1 765·81
Railroad accounts referred for settlement	32·18
Expenditures	1 797·99
Balance on hand—Report for 1893	3 152·26
Disallowed by Comptroller in accounts of John W. Parsons, Disbursing Agent	2·00
Railroad accounts referred for settlement as per Report for 1893, and returned for settlement by Disbursing Agent	36·91
	3 191·17
Expended since last report, as above	1 797·99
Present unexpended balance	1 393·18

General expenses, 1893.

INSTRUMENTS, INSTRUMENT SHOP, CARPENTER SHOP, DRAWING DIVISION, BOOKS, MAPS, CHARTS, AND SUBSCRIPTIONS.

To whom paid.	On what account.	Amount.
W. H. Lowdermilk & Co	Subscriptions	$5·00
Osmond Stone	Books	2·00
Gustav E. Stechert	do	27·50
Expenditures		34·50
Balance on hand—Report for 1893		121·20
Expended since, as above		34·50
Present unexpended balance		86·70

EXPENDITURES OF COAST AND GEODETIC SURVEY, 1894.

General expenses, 1893.

COPPERPLATES, CHART PAPER, PRINTING INK, COPPER, ZINC, AND CHEMICALS FOR ELECTROTYPING AND PHOTOGRAPHING; ENGRAVING, PRINTING, PHOTOGRAPHING, AND ELECTROTYPING SUPPLIES; EXTRA ENGRAVING AND DRAWING; PHOTOLITHOGRAPHING AND PRINTING FROM STONE AND COPPER FOR IMMEDIATE USE.

To whom paid.	On what account.	Amount.
J. C. Entwistle	Extra engraving	$91·00
Evans & Bartle	do	680·00
Expenditures		771·00
Balance on hand—Report for 1893		1 123·11
Expended since, as above		771·00
Present unexpended balance		352·11

MISCELLANEOUS EXPENSES, CONTINGENCIES OF ALL KINDS, OFFICE FURNITURE, REPAIRS, EXTRA LABOR, AND TRAVELING EXPENSES (OFFICE).

To whom paid.	On what account.	Amount.
Daily States Publishing Co	Advertising	$3·96
Expenditures		3·96
Balance on hand—Report for 1893		26·44
Expended since, as above		3·96
Present unexpended balance		22.48

RECAPITULATION.

[Showing expenditures in gross (by subitems) on account of the appropriation for General Expenses, 1893.]

Instruments, instrument shop, carpenter shop, drawing division, books, maps, charts, and subscriptions	$34·50
Copperplates, chart paper, printing ink, copper, zinc, and chemicals for electrotyping and photographing; engraving, printing, photographing, and electrotyping supplies; extra engraving and drawing; photolithographing and printing from stone and copper for immediate use	771·00
Miscellaneous expenses, contingencies of all kinds, office furniture, repairs, extra labor, and traveling expenses (office)	3·96
Total expenditures	809·46
Balance on hand—Report for 1893	1 291·12
Expended since, as above	809·46
Present unexpended balance	481.66

UNITED STATES COAST AND GEODETIC SURVEY,
OFFICE OF THE DISBURSING AGENT,
Washington, D. C., February 1, 1895.

I certify that the foregoing statement is a correct exhibit of all expenditures of the United States Coast and Geodetic Survey and of the Office of Standard Weights and Measures for the fiscal year ending June 30, 1894, and for all preceding years embraced within the limits of the law for making such expenditures, including all accounts rendered up to the close of business on January 31, 1895.

R. J. GRIFFIN,
Disbursing Agent U. S. Coast and Geodetic Survey.

Approved:
W. W. DUFFIELD,
Superintendent U. S. Coast and Geodetic Survey.

OFFICE REPORT No. 4.

REPORT OF THE ASSISTANT IN CHARGE OF STATE SURVEYS.

UNITED STATES COAST AND GEODETIC SURVEY,
Washington, D. C., October 25, 1894.

SIR: I have the honor to submit the following general report on the operations of the different parties under my charge engaged in work under the item in the Sundry Civil Act, entitled, "For furnishing points for State Surveys, etc," for the fiscal year ending June 30, 1894.

STATE OF NEW JERSEY.

The work in this State was continued by Prof. E. A. Bowser.

On July 5 Professor Bowser's party took the field and resumed work in the southern part of the State. During the rest of the month, and until August 2, he was engaged in making the necessary observations at Pine Hill Station. The party was then removed to Lippincott Station, and by the 11th they had finished the erection of the tripod and scaffold over the old 1843 station, which had fortunally been found the previous season. Observing poles were then erected at Taylor and Colson stations, and the poles at Burden Station adjusted. Observations were commenced on the 17th and finished on September 12. In the meantime the Station Burden was permanently marked.

Arrangements were then made to take down the tripod and scaffold at Williamstown Station, as we were through with it, and it had become so rotten as to endanger buildings standing near by. Field work was then closed for the season on September 16.

During November Professor Bowser was engaged sixteen days at his home in office work incident to his field season.

During the Easter vacation, from April 2 to April 10, 1894, he was engaged in reconnaissance on his lines to the south.

Expenditures for the fiscal year	$1 158·60

STATE OF TENNESSEE.

The work in this State has been continued by Prof. A. H. Buchanan.

At the close of the fiscal year, June 30, 1893, he had just got into camp at White Rock Station on the Virginia and Kentucky line, and was ready to commence observations. The work at this station was nearly completed by the 4th of July, when Professor Buchanan received positive information from some of the mountaineers who lived comparatively near his camp, that a band of about twenty Kentucky thieves and outlaws intended to make a raid the next day and destroy his camp and instruments, and that the lives of his party would be in danger.

He collected sixteen well-armed men from the surrounding country and awaited their coming. The next day two of the band made their appearance, and after a long consultation with him they agreed not to interfere with him, saying that they had been informed that he was making a survey which would deprive them of their lands and homes. If such was the case they had intended to run him out, as they had another surveyor four years previously. He satisfied them that such was not the case. A few days later, however, he heard that they had decided to run him out at any rate, and as he had nearly completed the station, and thinking "discretion the better part of valor," he gave it up and moved his camp and instruments down the mountain at once. He says in his report about the matter that "the man or party who goes there as I did without a guard of twenty-five good soldiers is simply foolhardy."

I think he was quite right in acting as he did.

A portion of his party moved his camp to Big Knob Station, while the Professor and his Recorder occupied six secondary stations for the purpose of determining points on the boundary line between Virginia and Tennessee. On the 17th of August they joined the rest of the party at Big Knob Station, and were engaged until the 7th of October in making the necessary observations there. While at this station the weather was very unfavorable for work.

On October 9 the camp outfit was started, in care of two men of the party, for Big Butt station. It was a hard and laborious move. In the meantime the Professor and his recorder occupied two more secondary stations, and reached camp at Big Butt on the 17th of October. Observations were immediately commenced, and the work at the station was completed on November 11. Camp was moved down the mountain on the 14th in a snowstorm. The party was discharged on the 15th and on the 17th the Professor reached his home at Lebanon, Tennessee, and field work for the season was closed.

The Professor was engaged at his home in office work until the end of the month.

From the 1st to the 16th of February, 1894, the Professor was in attendance at the Geodetic Conference in Washington, D. C., in compliance with the instructions of Superintendent Mendenhall.

On June 15 Professor Buchanan again took the field and reoccupied English Station, to measure some angles needed, owing to a change in his scheme, and at the close of the fiscal year, June 30, 1894, he was occupying Chimney Top Mountain, a secondary station.

He has, as heretofore, shown the most untiring zeal and industry in carrying on the work.

Expenditures for the year	$1 914·13

STATE OF MINNESOTA.

The work in this State has been continued by Professor W. R. Hoag.

At the close of the fiscal year June 30, 1894, he was engaged in the occupation of Ellsworth Station, on the Wisconsin side of the Mississippi River. The observations at this station were completed early in the month of July, and during the rest of the month the party was engaged in reconnaissance to determine the intervisibility of two doubtful lines and in the erection of tripod and scaffold signals at Alma and Watopa stations. Alma station was partly occupied in this month.

During the month of August the observations at Alma were completed and Watopa and Maxville stations were occupied, and a tripod and scaffold signal erected at Norton Station by the party under the Professor's charge.

In July Professor Hoag was appointed one of the judges of award at the Columbian Exposition at Chicago, and by the permission of Superintendent Mendenhall he went to Chicago on the 24th of the month and was engaged in his official duties there until the 21st of August, when he returned to his party. During his absence at Chicago the party was left in charge of Mr. Noah Johnson, who conducted the operations in a very satisfactory manner.

I was instructed by Superintendent Mendenhall to visit and inspect the party of Professor Hoag during the latter part of August, after his return from Chicago.

On the 25th I met the Professor by appointment on the train at Hastings, and we went to Lake City Station and occupied it together, while the rest of his party were erecting the signal at Norton Station.

His field work for the season was closed at the end of August and the party returned to Minneapolis.

On September 4th I inspected, in company with the Professor, the Snelling avenue base line and the work in the vicinity of Minneapolis, after which I left for Washington.

I found Professor Hoag a very energetic man, devoted to the best interests of the Survey, and fully capable of conducting the work in his charge in a very satisfactory manner.

During the winter months he was engaged a few days each month, when he could spare the time from his duties at the university, in bringing up his office work, which was several years in arrears.

During the first two weeks in February he was in attendance at the Geodetic Conference at Washington, in compliance with instructions of Superintendent Mendenhall.

On the 1st of June, 1894, he resumed field work in the vicinity of the Twin Cities, determining the magnetic declination at some of the old stations. On June 9 Assistant W. C. Hodgkins received instructions to proceed to Minneapolis and take charge of Professor Hoag's party for the purpose of determining such additional points in the vicinity of the Twin Cities as would enable Professor Hoag, as State Topographer, to commence a topographical survey of the State of Minnesota. He was also instructed to show to Professor Hoag the practical details of work with the plane table, as conducted by our Survey. Professor Hoag was attached to the party of Assistant Hodgkins during the season.

In consideration of the benefit that would accrue to the State by this arrangement the Board of Regents of the University agreed to pay all the expenses of the party, with the exception of the subsistence and traveling expenses to and from the field of Assistant Hodgkins, and the pay and subsistence of Professor Hoag.

Assistant Hodgkins proceeded to Minneapolis about the middle of June, and at the close of the fiscal year the work of the party was being actively carried on.

Expenditures for the fiscal year	$1 408·81

Recapitulation of the expenditures of the different parties during the fiscal year 1893–1894:

New Jersey, Prof. E. A. Bowser	$1 158·60
Tennessee, Prof. A. H. Buchanan	1 914·13
Minnesota, Prof. W. R. Hoag and Asst. W. C. Hodgkins	1 408·81
Total	4 481·54

Respectfully, yours,

GEORGE A. FAIRFIELD,
Assistant in charge of State Surveys.

GEN. W. W. DUFFIELD,
Superintendent Coast and Geodetic Survey,
Washington, D. C.

OFFICE REPORT No 5.

REPORT OF THE ASSISTANT IN CHARGE OF THE OFFICE OF STANDARD WEIGHTS AND MEASURES FOR THE FISCAL YEAR 1894.

United States Coast and Geodetic Survey,
Office of Standard Weights and Measures,
Washington, D. C., November 12, 1894.

Sir: I have the honor to submit the following report on the work of the Office of Standard Weights and Measures during the fiscal year ending June 30, 1894. As heretofore, the duties of the Office have consisted in making verifications of weights and measures for the National and State Governments, as well as for municipalities and individuals. A table showing the principal work done, aside from the preparation of State standards, in response to demands made upon this Office, is appended.

The preparation of five sets of weights and measures, intended for States which have not already received them, occupied much of the time of the Office

During the presence of Commandant Defforges of the French army, in this city, a comparison was made by him and Mr. L. A. Fischer, of this Office, between the pendulums swung by Commandant Defforges at the Coast and Geodetic Survey Office pendulum station, and National Prototype Metre No. 21.

During October a change was made in the place where the standards are kept by transferring them from the room in the third story of the Butler Building to one on the second floor, immediately below the old one.

The articles composing the Weights and Measures exhibit at the World's Fair, Chicago, were returned to this Office in good condition. Among them was a set of metric weights and measures which were verified after their return, and it was found that they had suffered no material change by their transportation to and from Chicago.

ELECTRICAL STANDARDS.

A bulletin, approved by the Secretary of the Treasury, was issued in December, 1893, by the Superintendent, announcing the formal adoption by the Office of Standard Weights and Measures, of the names and values of units of electrical measure, as defined by the International Congress of Electricians of 1893.

The personnel of the Office has remained unchanged. Mr. L. A. Fischer, Adjuster, had charge of the office, under the Superintendent's immediate direction, during my absence on field duty in Alaska, and until October 31, and again in June, 1894, during my assignment to topographic work in New England. Mr. C. A. Harbaugh performed clerical and other duties satisfactorily. The services of the mechanician and watchman are accounted for in the reports to the Assistant in charge of Office.

Yours, very respectfully,

O. H. Tittmann,
Assistani in charge of Office of Standard Weights and Measures.

Gen. W. W. Duffield,
Superintendent United States Coast and Geodetic Survey.

OFFICE OF UNITED STATES STANDARD WEIGHTS AND MEASURES.

ABSTRACT OF VERIFICATIONS OF WEIGHTS AND MEASURES MADE DURING THE FISCAL YEAR 1894.

Date.	Name.	Service.
1893.		
July	Evans, Richard, Jamaica, N. Y	Tape compared.
	United States Coast and Geodetic Survey Office	Tape compared.
	Munroe, Prof. C. E., Columbia University	Weights verified.
	City of Newark, N. J	Capacity measures adjusted.
	Richards, W. P., Washington, D. C	Two tapes compared.
	Ogden, Henry G., Norfolk, Va	Tape compared.
	Brown, Wm. L., Auburn, Ala	Information furnished.
	Treasury Department	Twenty-four caliper gauges adjusted.
August	Wolf, Frank A., United States Coast and Geodetic Survey.	Thermometer compared.
	Wood, F. A., Sec'y Meyer U. S. S. S. Co	Information furnished.
	Gibbons, R., Alameda, Cal	Information furnished.
	Rowland, Jonathan, Philadelphia, Pa	Standard metal gauge furnished.
	Baker, Chas. W., New York	Standard metal gauge furnished.
	Williams, Chas. P., Butler, Pa	Information furnished.
	Office of Engineer Commissioner, D. C	Tape compared.
	Roper, R. B. E., Orlando, Fla	Information furnished.
September	Douglas, H. T., Baltimore Topographical Survey	Tape compared.
	Paret, Milner P., Middleton, Md	Tape compared.
	Funk & Wagnalls Co., N. Y	Information furnished.
	United States Internal Revenue Bureau	Two hundred and eighty-six sugar flasks compared.
	Cornell University	Quartz weight compared.
	Fargusson, M., Southport, N. C	Information furnished.
	Heermans, H. C., Corning, N. Y	Tape compared.
	Power, Hon. T. C., United States Senate, Washington, D. C.	Information furnished.
October	Baltimore Copper Smelting and Rolling Co	Avoirdupois weights adjusted.
	Haywood, L. C., Pawtucket, R. I	Tape compared.
	Carhart, Prof. H. S., Michigan University	Information furnished.
	Wombwell, Hon. L. B., Tallahassee, Fla	Information furnished.
November	Reinert, Frederick, New York	Tape compared.
	Bostwick, L. A., Rensselaer, Ind	Tape compared.
	Funk & Wagnalls Co., New York	Information furnished.
	Souer, L. J., New Orleans, La	Quartz plate compared.
	Hartman, Hon. Chas. S., Bozeman, Mont	Information furnished.
	Fairbanks & Co., St. Johnsbury, Vt	Information furnished.
	Maurer, E. R., Acting State Sealer, Wis	Information furnished.
	Deitzgen & Co., Chicago, Ill	Two tapes compared.
December	North and South Dakota	Capacity measures adjusted.
	Putnam, G. R., Assistant Coast and Geodetic Survey	Magnetometer rods compared.
	Grimshaw, Robert, New York	Information furnished.
	North and South Dakota	Weights gilded.
	Alvord, H. E., Levinsville, Va	Information furnished.
	Putnam, G. R., Assistant Coast and Geodetic Survey	Magnet weighed.
	United States Coast and Geodetic Survey	Leveling rods compared.
1894.		
January	United States Coast and Geodetic Survey	Inertia ring compared.
	Howe Scale Co., Rutland, Vt	Weight compared.
	May & Co., F. P., Washington, D. C	Weight compared.
	United States Coast and Geodetic Survey	Magnet weighed.
	Lucas, Geo. F., Castile, N. Y	Tape compared.
	Crockett, Prof. C. W., Troy, N. Y	Information furnished.
	Kohlbusch, Herman, sr., New York	Weights adjusted.
	Patridge, Edw. A., Philadelphia, Pa	Weight adjusted.
	Estes, A. S. N., Newtonville, Mass	Tape compared.
	Hendrixson, Prof. W. S., Grinnel, Iowa	Weights adjusted.
	Squibb, E. R., Brooklyn, N. Y	Weights adjusted.

ABSTRACTS OF VERIFICATIONS OF WEIGHTS AND MEASURES—Continued.

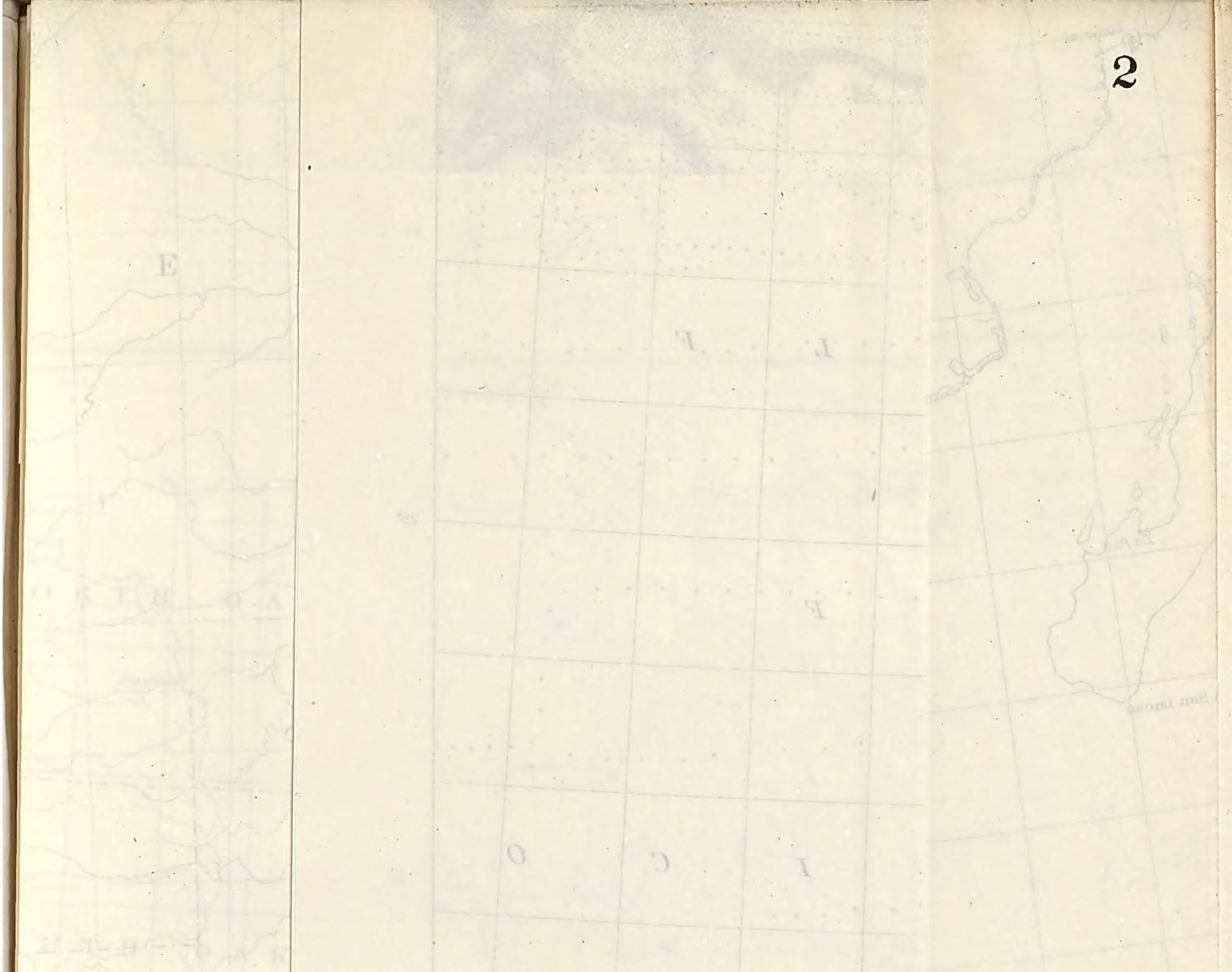
Date.	Name.	Service.
1894.		
February	Howe Scale Co., Rutland, Vt	Weights adjusted.
	Frank, E. H., Cincinnati, Ohio	Information furnished.
	Harkness, Prof. Wm., Washington, D. C	Tape compared.
	Lucas, Geo. F., Castile, N. Y	Tape compared
	Richards, R. H., Back Bay, Mass	Tape compared.
	Brown & Sharpe, Providence, R. I	Yard and metre compared.
March	United States Coast and Geodetic Survey	Six tapes compared.
	Brown, E. L., Brockton, Mass	Tape compared.
	Harkness, Prof. Wm., Washington, D. C	Tape compared.
	Thompson, E. P., Oxford, Ohio	Tape compared.
	United States Coast and Geodetic Survey	Pendulum weights gilded.
	Smith, E. F., Patchogue, N. Y	Tape compared.
	Rogers, Wm. A., Waterville, Maine	Information furnished.
April	Doran, E. W., Buffalo Gap, Texas	Information furnished.
	Kachelman, J., Evansville, Ind	Information furnished.
	Aloe & Co., St. Louis, Mo	Tape compared.
	Beach, C. E., Hartford, Conn	Tape compared.
	Lucas, Geo. F., Castile, N. Y	Tape compared.
	Funk & Wagnalls Co., New York	Information furnished.
May	Darling, Brown & Sharpe, Providence, R. I	Yard and meter compared.
	University of Vermont, Burlington, Vt	Tape compared.
	Wood, Geo. P., Baltimore Topographical Survey	Two tapes compared.
	Lippincott Co., J. B., Philadelphia, Pa	Information furnished.
June	University of Vermont, Burlington, Vt	Tape compared.
	Cornell University	Yard and metre compared.
	Hodgkins, W. C., Assistant Coast and Geodetic Survey.	Tape compared.
	Brown, W. H., Greenville, Tenn	Information furnished.
	Colorado State Agricultural College	Tape compared.
	Putnam, G. R., Assistant Coast and Geodetic Survey	Six pendulum thermometers compared.
	United States Coast and Geodetic Survey	Five pendulum thermometers compared.
	United States Engineer's Office, Vicksburg, Miss	Leveling rod compared.

U. S COAST AND GEODETIC SURVEY REPORT FOR 1894.

PART I.

PROGRESS SKETCHES.

No.	Title.
1	Sketch of general progress (eastern sheet).
2	Sketch of general progress (western sheet).
3	General chart of Alaska.
4	Progress of surveys for locating the boundary line between Alaska and the British Possessions in North America.
5	Map showing longitude stations and connections determined by the electric telegraph between 1846 and June 30, 1894.
6	Map showing positions of magnetic stations occupied between 1844 and June 30, 1894.
7	Maps showing lines of geodetic leveling run and positions of gravity stations to June 30, 1894.
8	Progress of surveys and resurveys between the St. Croix and Hudson rivers, with subsketch showing the surveys of the NE. boundary lakes.
9	Triangulation between the Atlantic coast and West Virginia, with subsketch showing progress of surveys near Charleston, S. C.
10	Triangulation between West Virginia and eastern Missouri, along or near the 39th parallel.
11	Triangulation between eastern Missouri and western Kansas, along or near the 39th parallel.
12	Triangulation between western Kansas and eastern Utah, along or near the 39th parallel.
13	Triangulation between eastern Utah and western Nevada, along or near the 39th parallel.
14	Triangulation between western Nevada and the Pacific coast, along or near the 39th parallel.
15	Progress of the surveys on the coast of Oregon and Washington, from Tillamook Bay to the boundary.
16	Sketch showing extension of triangulation from Atlanta Base to the Gulf of Mexico, with subsketch showing the triangulation in eastern Tennessee.
17	Progress of the surveys and resurveys of the Gulf coasts of Florida and Alabama.
18	Triangulation in the States of Wisconsin and Minnesota.
19	Reconnaissance for triangulation along the Rio Grande, from El Paso to the Gulf of Mexico.
20	Distribution of the principal astronomic latitude, longitude, and azimuth stations to June 30, 1894.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(*Alaska*) U.S.C. & G.S.

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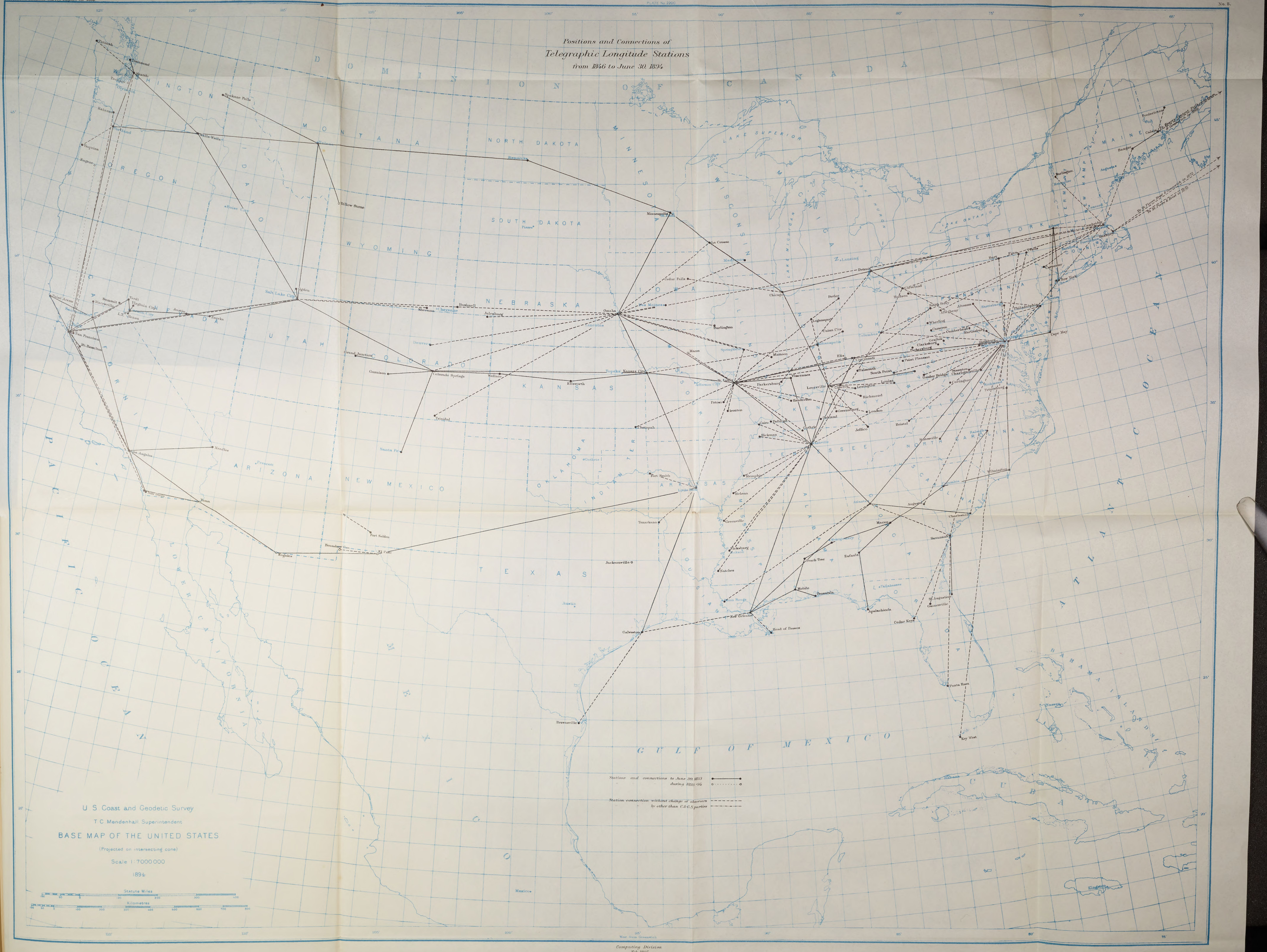
U.S. Coast & Geodetic Survey Report for 1894.

PLATE No. 2200

No. 8.



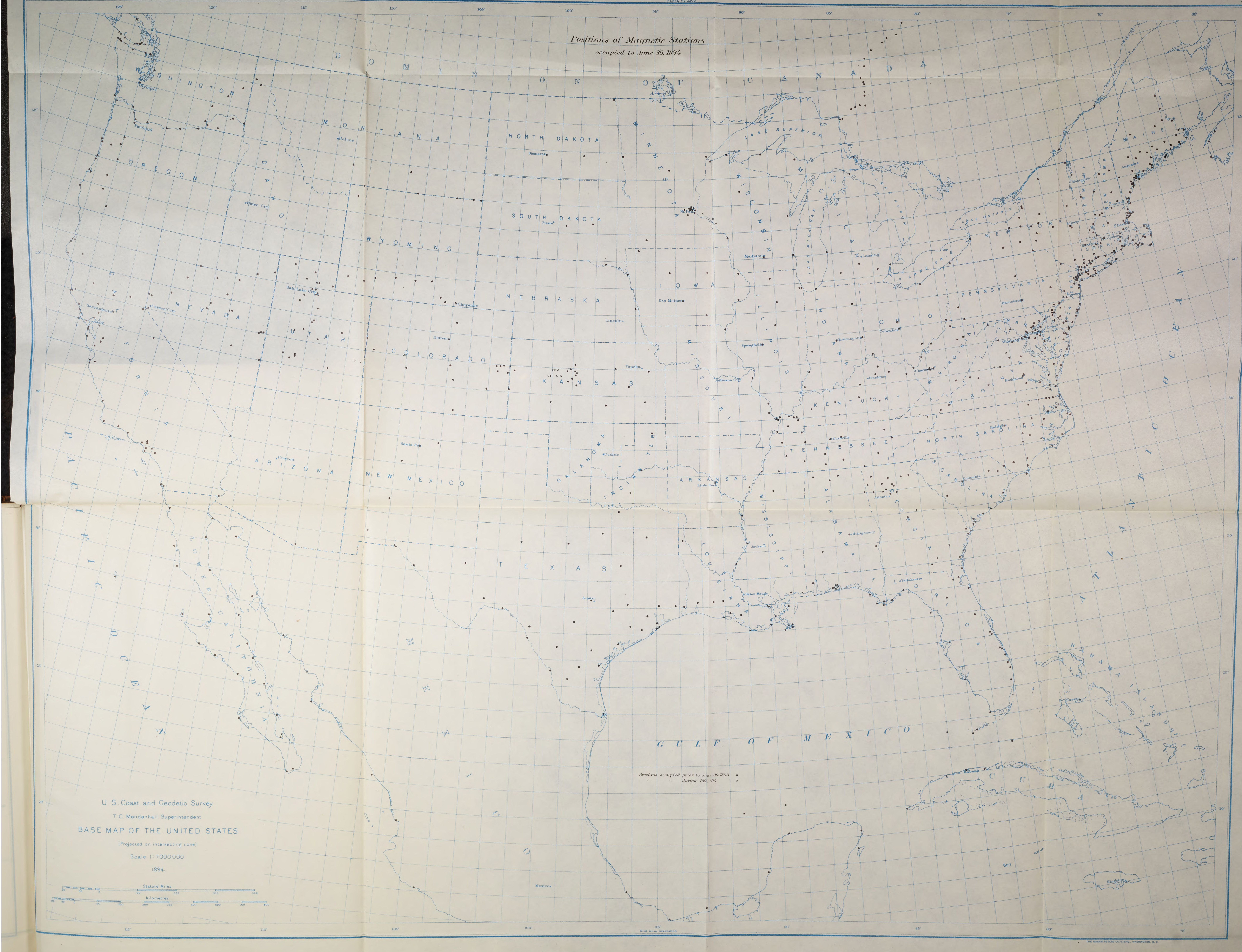
# Positions and Connections of Telegraphic Longitude Stations
from 1846 to June 30, 1894

Stations and connections to June 30, 1893 ●——●
" " " during 1893-94 ○ · · · · · ○

Station connection without change of observers - - - - -
" " by other than C.& G.S. parties -·-·-·-

U.S. Coast and Geodetic Survey
T.C. Mendenhall, Superintendent
BASE MAP OF THE UNITED STATES
(Projected on intersecting cone)
Scale 1:7000000
1894

Computing Division
Feb. 1895



Positions of Magnetic Stations
occupied to June 30, 1894

Stations occupied prior to June 30, 1893 ●
" " during 1893-94 ○

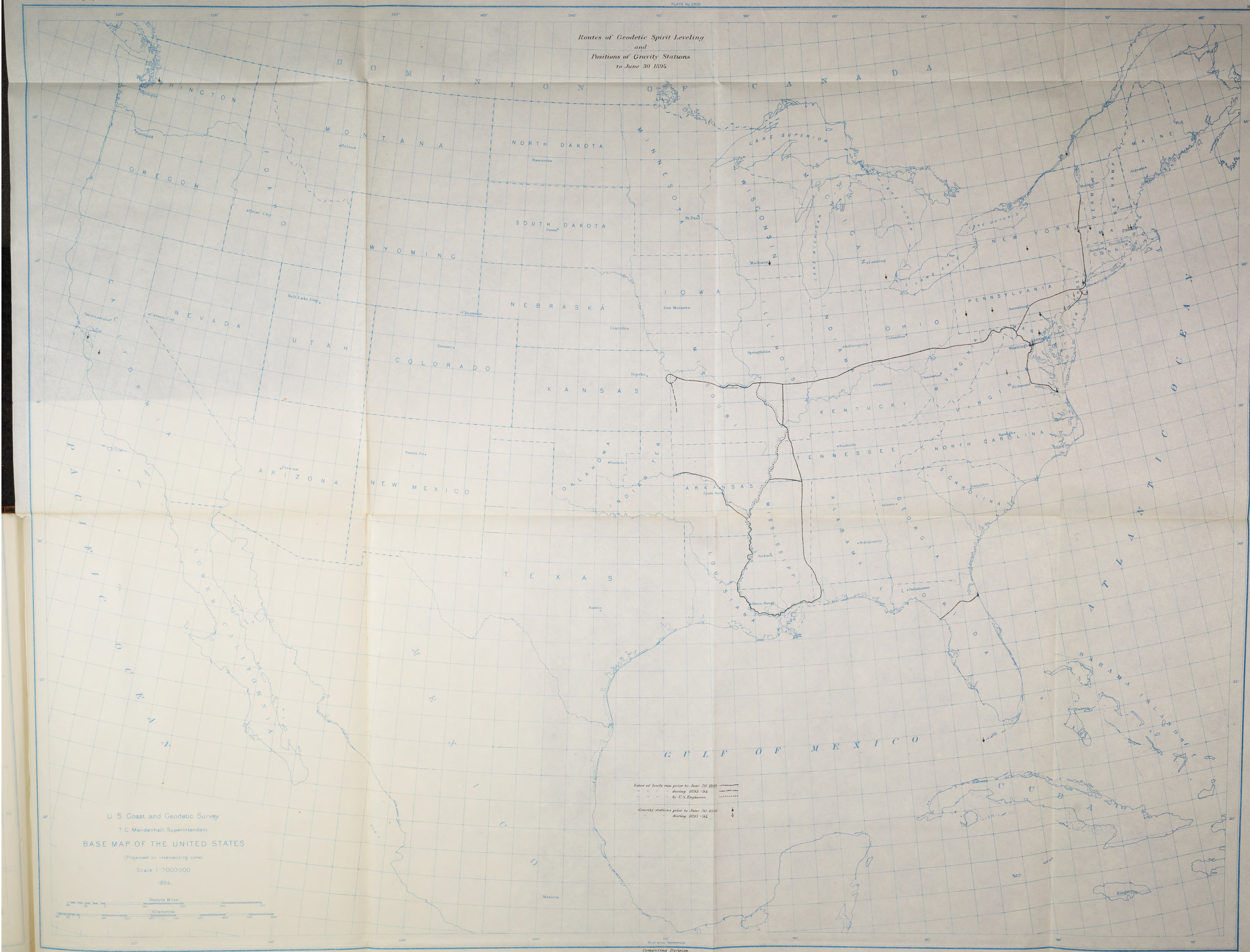
U.S. Coast and Geodetic Survey
T.C. Mendenhall, Superintendent
BASE MAP OF THE UNITED STATES
(Projected on intersecting cone)
Scale 1:7000000
1894.

THE NORRIS PETERS CO.-LITHO., WASHINGTON, D.C.

PLATE No. 2200

No. 7.

Routes of Geodetic Spirit Leveling
and
Positions of Gravity Stations
to June 30 1894



Lines of levels run prior to June 30 1893 ———
" " " " during 1893-94 — — —
" " " " by U.S. Engineers - - - - -

Gravity stations prior to June 30 1893 ●
" " during 1893-94 ○

U S. Coast and Geodetic Survey

T. C. Mendenhall, Superintendent

BASE MAP OF THE UNITED STATES

(Projected on intersecting cone)

Scale 1:7000000

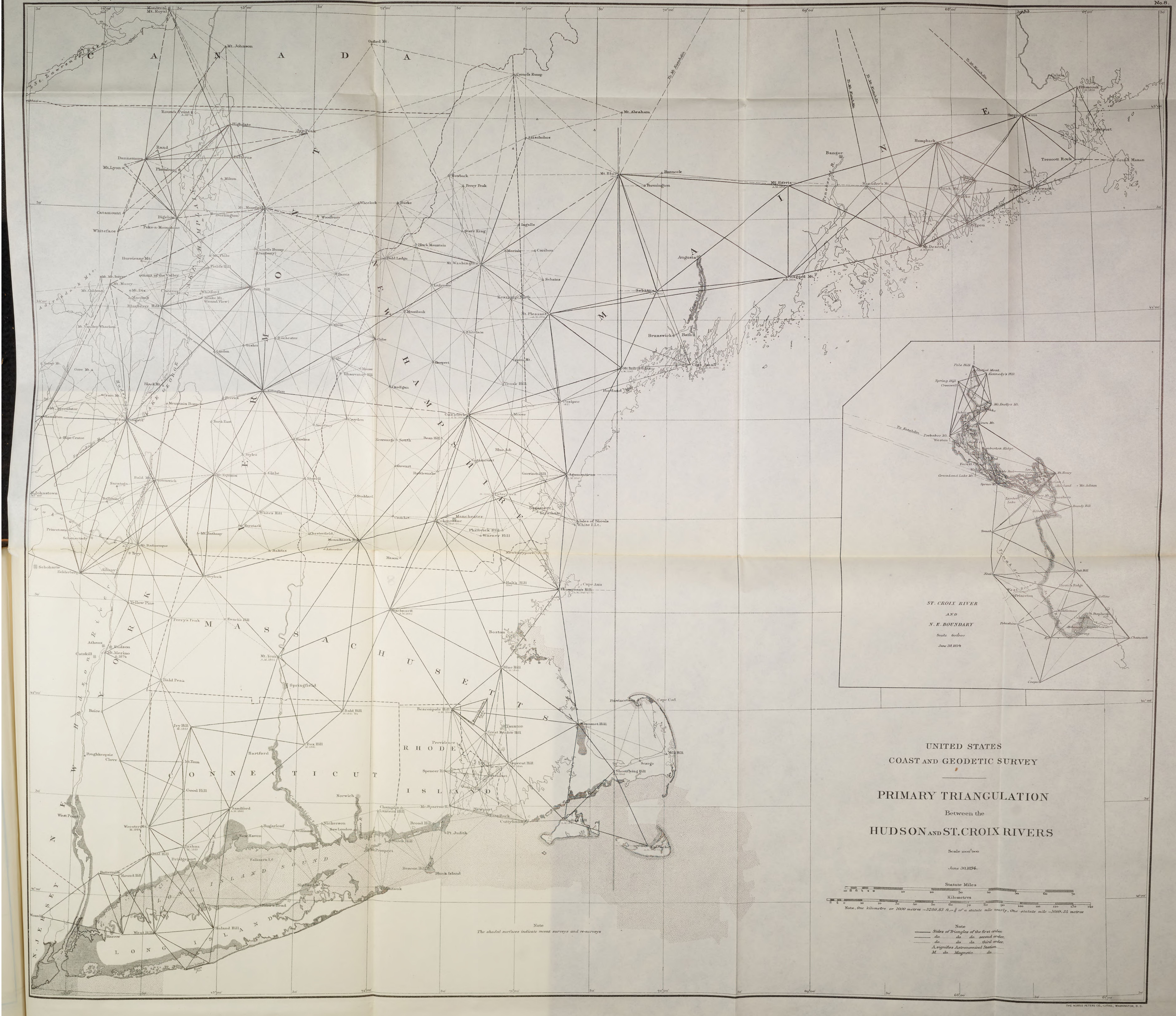
1894.

Statute Miles

Kilometres

Computing Division
Feb. 1895

THE NORRIS PETERS CO.-LITHO., WASHINGTON, D. C.



UNITED STATES
COAST AND GEODETIC SURVEY

PRIMARY TRIANGULATION
Between the
HUDSON AND ST. CROIX RIVERS

Scale 1/1000 000

June 30, 1894.

Statute Miles

Kilometres

Note. One kilometre or 1000 metres = 3280.83 ft. = 5/8 of a statute mile nearly. One statute mile = 1609.35 metres

Note
- Sides of Triangles of the first order.
- do do do second order.
- do do do third order.
- A. signifies Astronomical Station.
- M. do Magnetic do

THE NORRIS PETERS CO., -LITHO., WASHINGTON, D.C.

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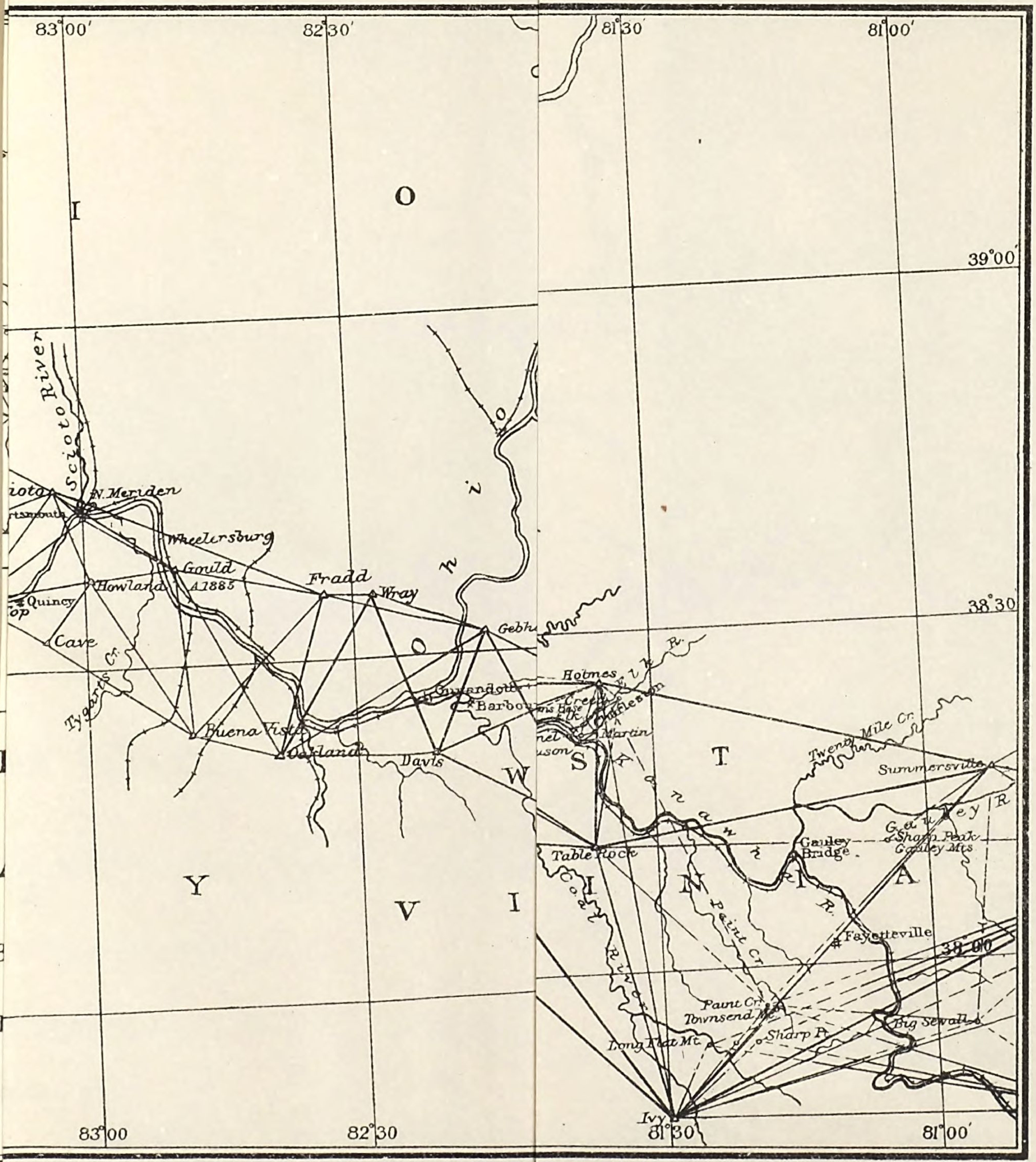
THE NORRIS PETERS CO.,-LITHO., WASHINGTON, D. C.

No.10.


83°00′
82°30′
81°30′
81°00′
39°00′
38°30′
38°00′
I
O
Scioto River
Scioto
Portsmouth
N. Meriden
Wheelersburg
Gould
△1885
Howland
Quincy
Cave
Tygarts Cr.
Fradd
Wray
Gebh
O
h
i
o
Guyandotte
Barbour
Buena Vista
Oakland
Davis
Holmes
Elk R.
Charleston
Martin
Twenty Mile Cr.
Summersville
Gauley R
Sharp Peak
Gauley Mts
Gauley Bridge
Table Rock
Coal River
Kanawha R.
Paint Cr.
Fayetteville
Paint Cr.
Townsend Mt.
Sharp Pt.
Long Flat Mt.
Big Sewall
Ivy
W
E
S
T
V
I
R
G
I
N
I
A
Y
83°00
82°30
81°30
81°00′

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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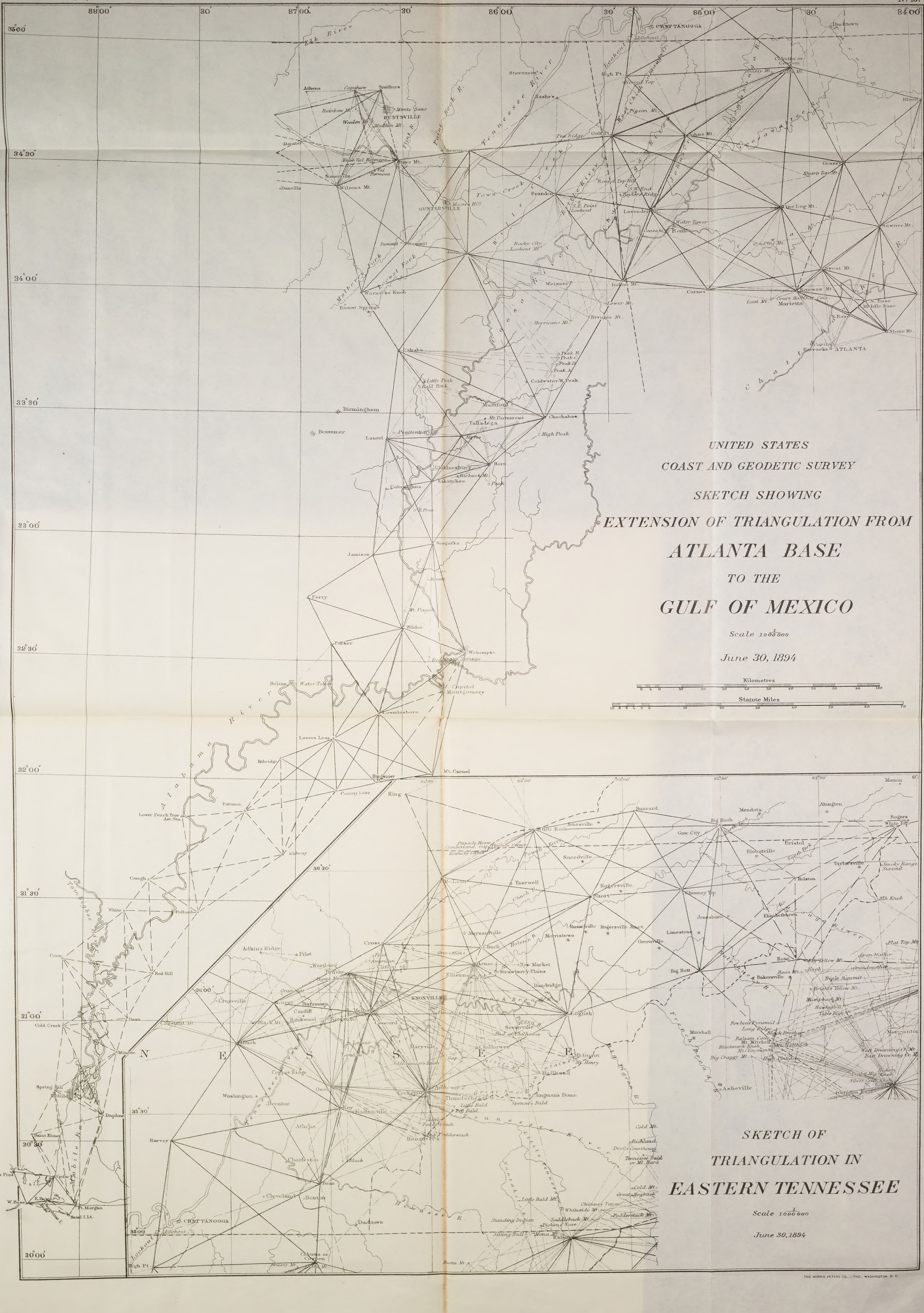


UNITED STATES
COAST AND GEODETIC SURVEY

SKETCH SHOWING
EXTENSION OF TRIANGULATION FROM
ATLANTA BASE
TO THE
GULF OF MEXICO

Scale $\frac{1}{1000000}$

June 30, 1894

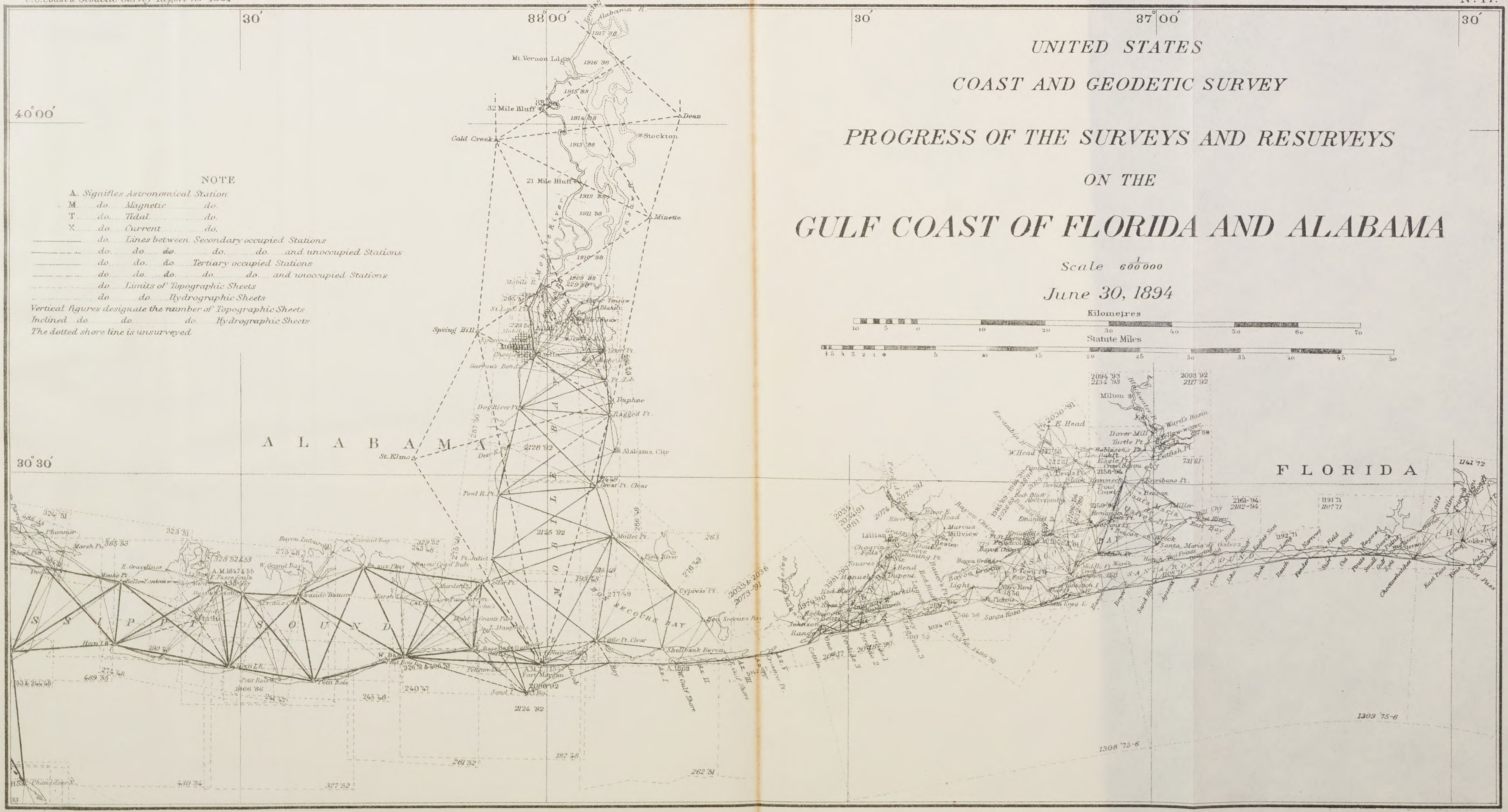
SKETCH OF
TRIANGULATION IN
EASTERN TENNESSEE

Scale $\frac{1}{1000000}$

June 30, 1894

THE NORRIS PETERS CO., LITHO., WASHINGTON, D.C.

U.S. Coast & Geodetic Survey Report for 1894 — Nº 17.



UNITED STATES
COAST AND GEODETIC SURVEY
PROGRESS OF THE SURVEYS AND RESURVEYS
ON THE
GULF COAST OF FLORIDA AND ALABAMA

Scale $\frac{1}{600000}$

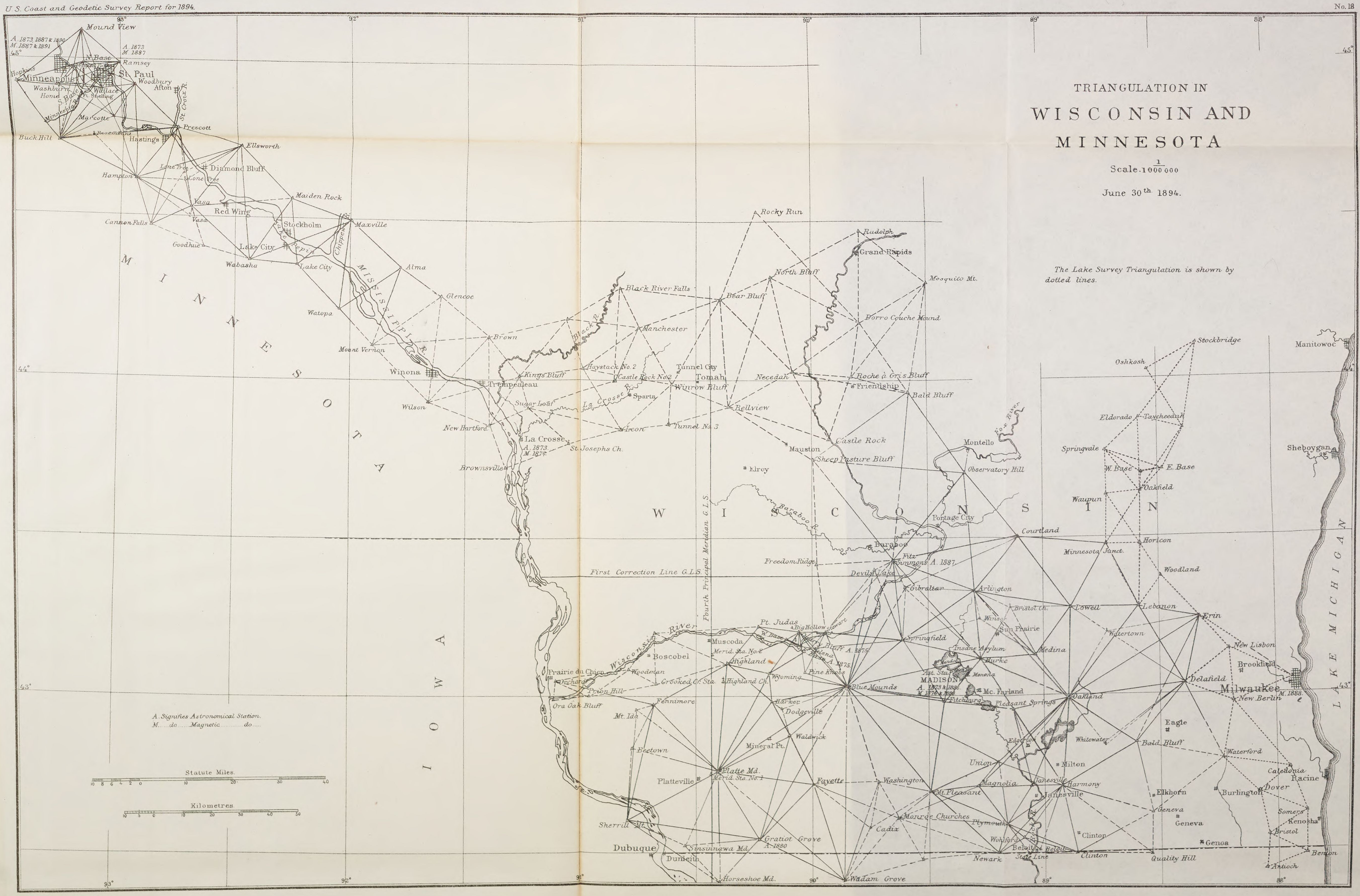
June 30, 1894

Kilometres
10 5 0 10 20 30 40 50 60 70

Statute Miles
5 4 3 2 1 0 5 10 15 20 25 30 35 40 45 50

NOTE

A. Signifies Astronomical Station
M. ..... do. ..... Magnetic ..... do.
T. ..... do. ..... Tidal ..... do.
X ..... do. ..... Current ..... do.
——— do. ..... Lines between Secondary occupied Stations
— — — do. ..... do. ..... do. ..... do. ..... do. ..... and unoccupied Stations
——— do. ..... do. ..... do. ..... Tertiary occupied Stations
— — — do. ..... do. ..... do. ..... do. ..... do. ..... and unoccupied Stations
.... do. ..... Limits of Topographic Sheets
.... do. ..... do. ..... Hydrographic Sheets
Vertical figures designate the number of Topographic Sheets
Inclined ..... do. ..... do. ..... do. ..... Hydrographic Sheets
The dotted shore line is unsurveyed



TRIANGULATION IN

WISCONSIN AND

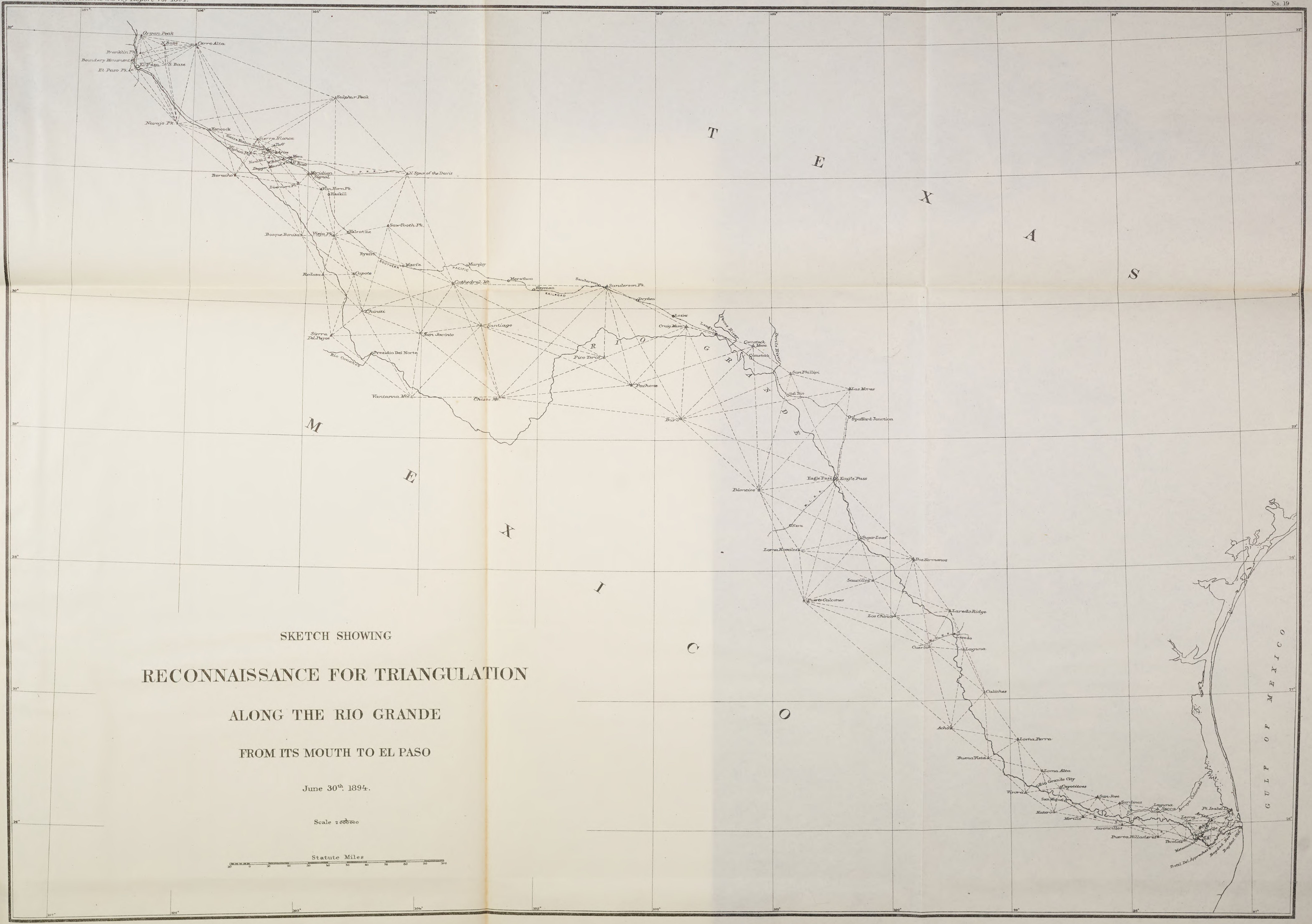
MINNESOTA

Scale. $\frac{1}{1000000}$

June 30th 1894.

The Lake Survey Triangulation is shown by dotted lines.

A. Signifies Astronomical Station.
M. ....do.... Magnetic ....do.....



SKETCH SHOWING

RECONNAISSANCE FOR TRIANGULATION

ALONG THE RIO GRANDE

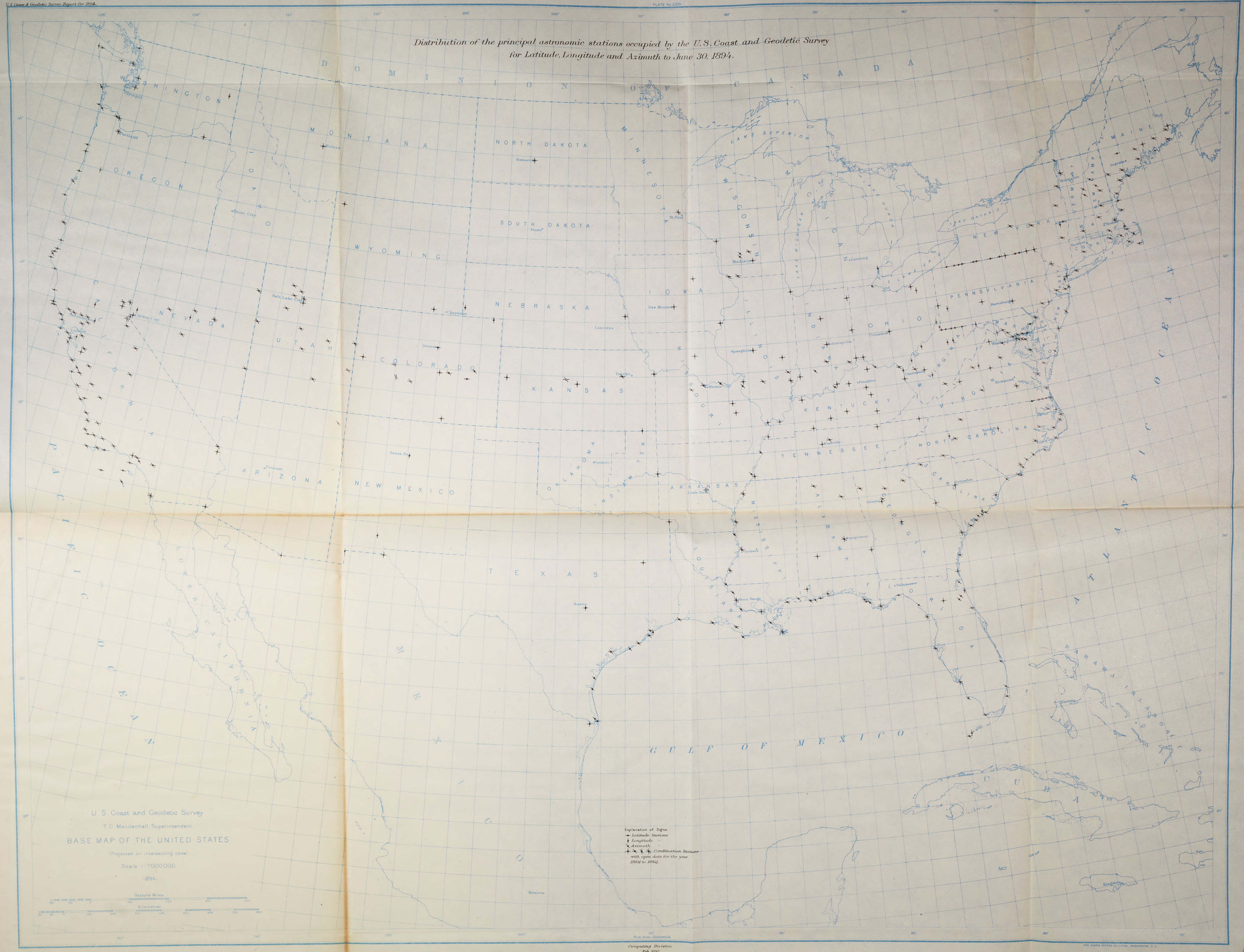
FROM ITS MOUTH TO EL PASO

June 30th. 1894.

Scale $\frac{1}{2\,000\,000}$

Statute Miles

10 0 10 20 30 40 50 60 70 80 90 100



Distribution of the principal astronomic stations occupied by the U.S. Coast and Geodetic Survey for Latitude, Longitude and Azimuth to June 30, 1894.

Explanation of Signs:
- *Latitude Stations*
- *Longitude* "
- *Azimuth* "
- *Combination Stations with open dots for the year 1893½ to 1894½.*

U. S. Coast and Geodetic Survey
T. C. Mendenhall, Superintendent
BASE MAP OF THE UNITED STATES
(Projected on intersecting cone)
Scale 1:7000000
1894.

Computing Division
Feb. 1895

THE NORRIS PETERS CO.-LITHO., WASHINGTON, D. C.

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BSB Bayerische StaatsBibliothek
MDZ Münchener DigitalisierungsZentrum Digitale Bibliothek

Senate documents

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Washington, DC 1896

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